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From the rich collection of the 1936 Michigan-Carnegie expedition to British Honduras, obtained through support of the Horace H. Rackham School of Graduate Studies, University of Michigan, six additional new species are described. Thirty-four other novelties have been found in the same collection, twenty-six of which have already been published. Since the writer's general account of the vegetation of the limestone plateau and the Mountain Pine Ridge, the principal areas covered by the expedition, as well as the records of the numerous new additions to the British Honduras flora, will not appear until further systematic studies have been completed, a map of the country, showing collection localities, is included now for the benefit of collaborators (Fig. 1).

Through a personal gift from Dr. E. B. Mains, Director of the University of Michigan Herbarium, it was possible to send our native British Honduras collector, Percy H. Gentle, to Vaca in El Cayo District from February through May, 1938 to accumulate further material from the section visited by Dr. Mains and the writer in 1936. Mr. Gentle obtained 451 collections which not only add a number of species to the flora, but contain some surprising new ones. Among these is *Diphyssa macrophylla*, included in this paper. Since completing his work at Vaca, he has resumed collecting in the Stann Creek Valley.

In August 1938 Mr. Eizi Matuda botanized on Mt. Tacana, a volcanic peak 4062 meters high which straddles the boundary between Mexico and Guatemala. The percentage of endemics is comparable to that of other peaks of southern Mexico and Guatemala. Mr. Matuda's intensive explorations on Mt. Ovando, near Escuintla, Chiapas, continue to yield much

¹ Papers from the Herbarium of the University of Michigan. Previous issues of this series have appeared as follows: I, Carnegie Inst. Washington Publ. 478:208-221. 1937; II, Phytologia 1:212-222. 1937; III, *ibid.* 1:241-247. 1937; IV, Field and Laboratory 6:9-16. 1937; V, Amer. Midland Nat. 19:427-432. 1938; and VI, *ibid.* 20:236-242. 1938.

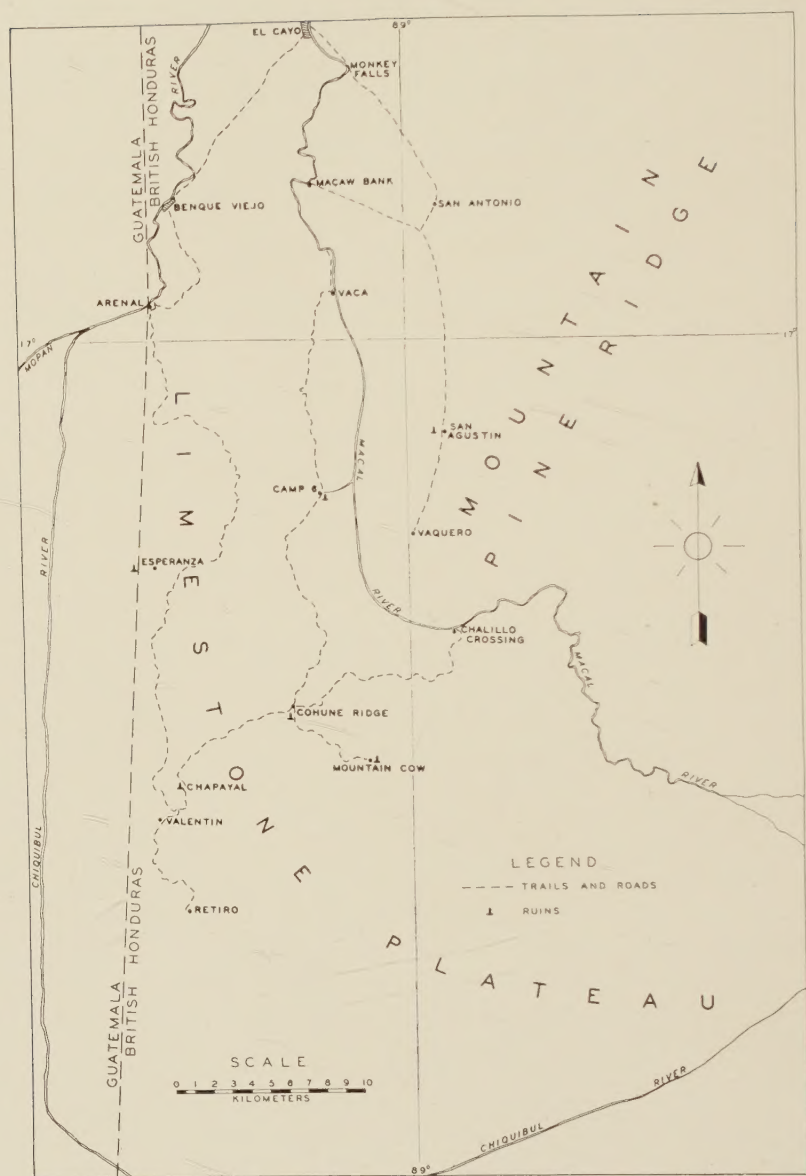


Fig. 1. Areas of El Cayo District, British Honduras visited by the 1936 Michigan-Carnegie expedition. The map is based on government surveys of British Honduras generously made available by Mr. N. S. Stevenson, Conservator of Forests.

of interest as evidenced by the striking new cycad, *Ceratozamia Matudai*. Sixteen species are described from his collections.

In the course of the studies, the writer has borrowed types and other specimens from the Field Museum Herbarium, New York Botanical Garden, Gray Herbarium, Yale School of Forestry, U. S. National Herbarium, DePauw University Herbarium, and the University of California Herbarium at Berkeley. Grateful acknowledgement is made to the directors and curators of these institutions. To the Carnegie Institution of Washington the writer expresses his thanks for financial support of both field and herbarium studies. Especial indebtedness is acknowledged to Dr. A. V. Kidder whose continued interest has made possible much of the work in the Maya area.

CYCADACEAE

***Ceratozamia Matudai* sp. nov.**

Truncus 30—50 cm. altus, 15—20 cm. diam. Folia 75—122 cm. longa, glabra. Petiolus basi dense tomentosus, subteres, aculeis brevibus pungentibus plus minus armatus. Rachis supra bisulcata, aculeolis raris armata. Foliola 23—44-juga, subopposita vel alterna, lineari-lanceolata, 20—38 cm. longa, 6.5—15 mm. lata, supra basin constricta, attenuata, acuta, subarcuato-patentia, integra, coriacea, nervis 6—11. Strobilus ♂ cylindrico-oblongus, 8—16 cm. longus, 3—4.5 cm. diam., pedunculo 8—11 cm. longo. Microsporophylla 1—2.1 cm. longa, 8—11 mm. lata, parte fertili 6—12 mm. longa, bicornuta. Strobilus ♀ ellipsoideus, ca. 15 cm. longus, 9 cm. latus, pedunculo 17—22 cm. longo. Peltae transverse hexagonae, 3.5 cm. latae, 1.8 cm. altae, basi tomentosae, in medio bicornutae. Semina obovoidea, ca. 3 cm. longa, 2.3 cm. diam.

Trunk 30 to 50 cm. tall, 15 to 20 cm. in diam. Leaves 75 to 122 cm. long, glabrous. Petioles armed with few short stout spines, subterete, the broad base densely and persistently tomentose, glabrous otherwise. Rachis flattened and shallowly bisulcate above, bearing a few short stout prickles, excurrent at apex. Leaflets 23 to 44 pairs, subopposite to alternate, linear-lanceolate, 20 to 38 cm. long, 6.5 to 15 mm. wide, the basal and apical shortest, widest above the constricted base, tapering to a long slender point, subarcuate-patent, coriaceous, yellow-green, shining above, entire, 6- to 11-veined, veins prominulous beneath, obscure above. Staminate strobile cylindric-oblong, slightly narrowed toward the apex, abruptly and stoutly apiculate, 8 to 16 cm. long, 3 to 4.5 cm. in diam., peduncle 8 to 11 cm. long, covered with small red scales, appressed hirsute at base, thick at apex, gradually narrowed to the constricted base. Microsporophyll 1 to 2.1 cm. long, 8 to 11 mm. wide, broadest at the center, fertile part 6 to 12 mm. long, cuneate, sterile part 3.5 to 10 mm. long including horns, truncate-pyramidal, bearing two pointed horns 1.5 to 4 mm. long at apex,

the horns suberect to strongly divaricate. Mature fruiting strobile ellipsoid, about 15 cm. long, 9 cm. in diam., peduncle longer than cone, up to 22 cm. long, stout, rarely armed, appressed-hirsute and red scaly at first, glabrescent with age. Pelta transversely hexagonal, up to 3.5 cm. wide, 1.8 cm. high, base tomentose and red scaly, medially bicornute, the horns strongly divaricate, glabrous, their base red scaly, elevated. Seed obovoid, about 3 cm. long, 2.3 cm. in diam.

Type in the Herbarium of the University of Michigan, *Eizi Matuda 2645*, staminate plant, collected in broad leaved forest on northern slope of Mt. Ovando, Chiapas, Mexico, February 1939; alt. 1000 m.

Additional specimens examined: MEXICO: Chiapas, Mt. Ovando, on northern slope, Feb. 1939, *Matuda 2646* (mature fruit); Dec. 1937, *Matuda 2087*.

Through repeated trips to Mt. Ovando Mr. Matuda obtained complete material of the species, and it is with pleasure that I name it for him. *C. Matudai* may be readily separated from *C. mexicana* Brongn. and *C. Kuesteriana* Regel by its much longer peduncles and larger microsporophylls. On the basis of leaf nervation, it is nearest *C. Kuesteriana*, but differs, aside from the characteristics mentioned, in having armed petiole and rachis.

ARACEAE

Monstera belizensis sp. nov.

Caudex scandens. Folia oblique ovato-oblonga vel lanceolato-oblonga, 32—44 cm. longa, 13—20.5 cm. lata, apice angustata, rotundata et apiculata vel late obtusa et apiculata, basi rotundata, inaequilatera, integra, nunc pauciforaminata, nervis lateralibus I utrinque 9—12; petiolis 22—27 cm. longis. Pedunculus ca. 7 cm. longus, 8—10 mm. crassus. Spadix cylindricus, 15 cm. longus, ca. 3.5 cm. diam. Baccae 7—9 mm. longae. Stylus 4—6 mm. longus, truncatus. Semina 1 vel 2, oblongo-ellipsoidea, lateraliter compressa, 6.5—9 mm. longa, 5—6 mm. lata.

A large scandent vine, growing on tree trunks. Leaves thin, obliquely ovate-oblong or lanceolate-oblong, 32 to 44 cm. long, 13 to 20.5 cm. wide, apex narrowed, rounded and apiculate or broadly obtuse and apiculate, base rounded, inaequilateral, usually entire, rarely pertuse with 1 or 2 small holes remote from costa, main lateral veins 9 to 12 on each side, veinlets prominulous on both surfaces; petioles 22 to 27 cm. long, vaginate to middle of geniculus, which is 1.5 to 2.5 cm. long. Peduncles about 7 cm. long, 8 to 10 mm. thick. Spathe deciduous, not seen. Spadix in fruit sessile, cylindrical, tapering slightly from base to apex, 15 cm. long, about 3.5 cm. in diam. at base. Water soaked fruits cylindrical, 7 to 9 mm. long (excluding style), 1- or 2-seeded, the seed oblong-ellipsoid, slightly compressed laterally, 6.5 to 9 mm. long, 5 to 6 mm. wide; the style cylindrical, 4 to 6 mm. long, truncate or slightly concave; the stigma plane, slightly elevated in dried fruits.

PLATE I



PLATE I. *Monstera tuberculata* Lundell. Type (Lundell 6238) in Herbarium of the University of Michigan. $\times \frac{1}{2}$.

Type in the Herbarium of the University of Michigan, *C. L. Lundell* 6198, collected in advanced, valley forest at Valentin, El Cayo District, British Honduras, June 23, 1936.

M. belizensis with its usually entire but sometimes pertuse leaves keys immediately to *M. Brownii* Sp. Moore in the Pflanzenreich. That Brazilian species, with peduncles twice as long, much smaller spadices, and seeds wider than long, is evidently the closest relative.

***Monstera tuberculata* sp. nov.**

Caudex alte scandens, internodiis 4—8 cm. longis. Folia juvenula sub spadice oblique ovato-lanceolata, 10—16 cm. longa, 5.5—9 cm. lata, apice attenuata, subacuminata, basi subcordata, integra, inaequilatera; petiolis 3—5 cm. longis. Pedunculi 5—6.5 cm. longi. Spadix oblongo-ellipsoideus, 5.7—6.5 cm. longus, 2.5—2.8 cm. crassus. Pistilla oblongo-ovoidea, stilum conicum, 4—5 mm. longum.

A fleshy vine hanging in masses from crowns of highest trees, internodes 4 to 8 cm. long. Young leaves, below the spadices, obliquely ovate-lanceolate, 10 to 16 cm. long, 5.5 to 9 cm. wide, apex attenuate, subacuminate, base subcordate, integral, inaequilateral, veinlets reticulate; petioles 3 to 5 cm. long, slender, sulcate, broadly winged to within 6 to 8 mm. from base of blade, the wings at that point uniting to form an attenuate-acuminate appendage 3.5 to 4.5 cm. long. Peduncles 5 to 6.5 cm. long. Spathe deciduous. Spadix oblong-ellipsoid, 5.7 to 6.5 cm. long, 2.5 to 2.8 cm. wide. Pistils oblong-ovoid, constricted into a conical style 4 to 5 mm. long, giving the spadix a tuberculate appearance; stigma small.

Type in the Herbarium in the University of Michigan, *C. L. Lundell* 6238, collected on trees in high advanced forest, Valentin, El Cayo District, British Honduras, June 25, 1936.

A sterile collection from the same locality, *Lundell* 6337, taken from a plant growing closely pressed to a tree trunk, has mature broadly ovate, deeply cordate, subacuminate leaves up to 23 cm. long and 16 cm. wide with winged appendaged petioles only 3 cm. long.

M. tuberculata is close to *M. acuminata* C. Koch, but, according to description, appears amply distinct, and may be differentiated by leaf form, comparative lengths of petioles in young and mature leaves, petiole appendage, much longer peduncles, and larger spadices.

DIOSCOREACEAE

***Dioscorea tacanensis* sp. nov.**

Volubilis. Caulis sulcatus, subglaber. Folia longe (usque ad 7.5 cm.) petiolata, alterna, glabra, membranacea, late ovata, 8—15 cm. longa, 5—10.5 cm. lata, apice abrupte caudato-acuminata, basi cordata, 11—15-nervia. Inflorescentiae ♀ racemosae. 1 vel 2 fasciculatae in axilla folii.

pedunculatae, usque ad 11 cm. longae; rachis et pedunculus glanduloso-puberuli. Pedicelli ante anthesin ca. 1 mm. longi. Segmentae perianthii ♀ lanceolato-ellipticae, usque ad 1.5 mm. longae, intus minute puberulae. Staminodia 3. Stigmata sessilia. Pedicelli fructiferi usque ad 7 mm. longi. Capsulae quasi-unialatae, inaequilaterales, usque ad 1.4 cm. longae, 1.1 cm. latae.

A scandent vine; stems slender, very sparingly puberulent, essentially glabrous, sulcate. Leaves alternate, glabrous, thinly membranaceous, broadly ovate, 8 to 15 cm. long, 5 to 10.5 cm. wide, apex abruptly caudate-acuminate, the acumen up to 2.5 cm. long, base deeply cordate, the sinus broad, 11-15-veined, the veins prominulous on undersurface. Petioles up to 7.5 cm. long, sulcate, very sparsely puberulent or glabrous. Pistillate inflorescence racemose, racemes 1 or 2 in the leaf axils, up to 11 cm. long including peduncle, rachis glandular-puberulent, striate. Pedicels of pistillate flowers solitary, about 1 mm. long at anthesis, accrescent. Perianth segments minutely and densely puberulent within, alternate ones sparsely puberulent below outside, otherwise glabrous, lanceolate-elliptic, up to 1.5 mm. long. Staminodia 3. Stigma sessile or nearly so. Pedicels of fruits very slender, up to 7 mm. long, capsules inaequilateral, up to 1.4 cm. long, 1.1 cm. wide, two wings abortive, the third accrescent, thin. Seeds solitary, up to 6 mm. long, almost 5 mm. wide, surrounded by a very narrow wing.

Type in the Herbarium of the University of Michigan, *Eizi Matuda 2416*, collected on Mt. Tacana, Chiapas, Mexico, Aug. 1938; alt. 1000—2000 m.

Although staminate flowers are not available, the species appears very closely related to *D. cyphocarpa* Rob., therefore referable to the subgenus *Eudioscorea*, section *Polyneuron*. By abortion the capsules are one-winged. The shorter fruiting pedicels, smaller capsules, puberulent perianth, and sessile stigma differentiate the species from *D. cyphocarpa*.

BETULACEAE

***Carpinus tropicalis* (Donn. Sm.) comb. nov.**

Carpinus americanus Michx. var. *tropicalis* Donn. Sm., Bot. Gaz. 15:28. 1890.

A tree of the mountains; branchlets, petioles, and peduncles densely pubescent. Leaves ovate-lanceolate, ovate or ovate-oblong, usually 4 to 7 cm. long, sometimes smaller, 1.5 to 3.5 cm. wide, apex acuminate, base rounded or subcordate, biserrate, costa prominent beneath, nearly plane above, appressed pilose on both surfaces, barbate in the axils of the veins, main lateral veins usually 11 or 12 on each side, sometimes as many as 14, prominent and appressed pilose beneath, prominulous and glabrescent above, secondary and tertiary veinlets reticulate, often prominulous on both surfaces; petioles 5 to 13 mm. long. Staminate inflorescence (*Matuda*

2256) 1.5 to 2.5 cm. long, the rachis pubescent; bracts ovate, about 4.5 mm. long, acuminate, ciliate; stamens 7 to 13, pilose at apex. Infructescence 3.5 to 6 cm. long, the peduncle and rachis densely pubescent; bracts 3-lobed, 1.5 to 2.4 cm. long, areolate, appressed pubescent outside, densely so at base and along midvein, sparingly hairy within, prominently reticulate veined, areolate, especially outside, the medial lobe oblong-lanceolate, sparingly dentate, usually above the middle, or subentire, apex usually obtusish and mucronulate, lateral lobes small, acutish. Nuts ovoid, slightly compressed, appressed pubescent, 5 to 6 mm. long.

Specimens examined: GUATEMALA: Department of Alta Verapaz, Chicoyonito, April 1889, *J. Donnell Smith* 1667, type in U. S. Nat. Herb. MEXICO: Chiapas, Siltepec, Aug. 10, 1937, *E. Matuda* 1612; Mt. Paxtal ("Pasitar"), Aug. 1937, *Matuda*; Mt. Ovando, April 9-12, 1937, *Matuda* 1855; Mt. Paxtal ("Pasitar"), Dec. 1936, *Matuda* 2256.

C. tropicalis is admittedly very close to *C. caroliniana* Walt. The dense pubescence, smaller leaves with prominulous secondary and tertiary veinlets, acuminate bracts of the staminate inflorescence, and the reticulate veined bracts of the fruits are differentiating characteristics.

MORACEAE

TROPHIS CUSPIDATA Lundell, Amer. Midland Nat. 19:427, 1938.

This well marked species, described from staminate material gathered by Mr. Matuda on Mt. Ovando, Chiapas in December 1936, was obtained by the same collector with pistillate flowers during August 1938 on Mt. Tacana. *Eizi Matuda* 2370, a tree 10 to 12 m. high, 30 cm. in diam., collected on Mt. Tacana, Chiapas, Mexico, Aug. 1938; alt. 2000-4038 m. The original description may now be amplified.

Petioles up to 2 cm. long. Leaf blades oblong or oblong-elliptic, up to 25 cm. long, 7 cm. wide, the cusp as much as 3 cm. long, the undersurface paler, tawny, and densely pilose, primary veins 6 to 11 on each side, arcuately ascending, anastomosing into a prominent submarginal vein. Pistillate inflorescence racemose, solitary, axillary, 4 to 9 cm. long including peduncle 0.7 to 2 cm. long, the peduncle and rachis finely tomentose. Pedicels 1.5 to 3 mm. long, the pedicels and perianth tomentose. Ovary semi-inferior, glabrous, enclosed in the perianth, 1-celled with a single suspended ovule. Stigma sessile or subsessile, bilobed, the lobes linear, divaricate, densely puberulent. Young fruits broadly obovoid, borne on pedicels up to 1 cm. long.

TROPHIS GLABRATA Liebm., Dansk. Vid. Selsk. Skrivt. V. 2:314. 1851.

This species should not be confused with *T. racemosa* (L.) Urban to which it was questionably referred by Standley (Contrib. U. S. Nat. Herb. 23: 205. 1922). From examination of the type photograph in the University of Michigan collection, *T. glabrata* is amply distinct from any of the

species of this genus known to the writer. Its short petioles, rounded leaf base, cuspidate apex, and 12 to 14 nearly horizontal primary veins are noteworthy. The type is a sterile twig.

***Trophis Matudai* sp. nov.**

Arbor. Ramuli parce et breviter pilosi, mox glabrescentes. Folia 5—12 mm. longe petiolata, membranacea vel chartacea, oblongo-elliptica vel obovato-oblonga, 7—15 cm. longa, 2.3—5.5 cm. lata, apice abrupte acuminata, acumine obtuso, basi obtusiuscula, subintegra vel superne serrulato-dentata, glabra. Inflorescentiae fem. solitariae vel geminatae, axillares, subspiciformes, 3.5 cm. longae vel minores, albido-tomentosae. Florum fem. perigonium brevissime tomentosum. Stylus exsertus, glaber. Stigma bilobum, lobis brevissime tomentosis, ca. 4 mm. longis. Fructus obovoideus, costatus, subsessilis vel pedicellatus.

A tree; branchlets slender, sparsely short pilose at first, glabrescent early. Stipules up to 2.5 mm. long, subulate. Petioles 5 to 12 mm. long, slender, canaliculate, sparsely short pilose at first. Leaf blades membranaceous or thin chartaceous, oblong-elliptic or obovate-oblong, 7 to 15 cm. long, 2.3 to 5.5 cm. wide, apex abruptly acuminate, the acumen obtuse, usually 1 to 1.5 cm. long, base obtusish, subentire or remotely serrulate-dentate above, the serratures small and rounded, at first with a few short hairs on the veins, entirely glabrous early, costa slender but prominent beneath, plane above, primary veins 5 to 7 on each side, prominulous on undersurface, slightly impressed above or plane, strongly arcuately ascending, veinlets openly reticulate. Pistillate inflorescence subspicate, solitary or geminate in the leaf axils, the rachis up to 3.5 cm. long, finely white tomentose. Flowers sessile or pedicellate, the pedicels not over 1 mm long, white tomentose. Perianth white tomentose, enclosing the semi-inferior ovary. Ovary glabrous, 1-celled, with 1 suspended ovule. Style glabrous, exserted, about 1.2 mm. long. Stigma bilobed, the lobes linear, divaricate, short tomentose, up to 4 mm. long. Young fruits obovoid, costate, glabrescent, sessile or pedicellate, the pedicels up to 3 mm. long.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2091, collected on Mt. Ovando, near Escuintla, Chiapas, Mexico, Dec. 1937. *Matuda* 576 from the same locality is referable here.

T. Matudai, although closely related to *T. racemosa* (L.) Urban, may be readily separated from that species by its thin smooth leaves, elongate pistillate inflorescence, exserted style, and costate glabrescent fruit.

LORANTHACEAE

***Struthanthus belizensis* sp. nov.**

Frutex epiphyticus omnino glaber. Folia rigida coriacea, orbicularia vel late elliptica, 5—9 cm. longa, 4.8—7.5 cm. lata, apice late rotundata vel

PLATE 2



PLATE 2. *Struthanthus belizensis* Lundell. Type (Lundell 6973) in Herbarium of the University of Michigan. $\times \frac{1}{2}$.

emarginata, breviter apiculata, basi late rotundata; petiolo crasso, 1—1.8 cm. longo. Inflorescentiae subspicato-racemosae, 4.5—13 cm. longae, axillares, solitariae. Flores sessiles, virides. Petala 6, linearia, 7 mm. longa, acutiuscula. Filamenta sursum brevissime libera. Stylus 5 mm. longus.

A woody epiphyte, entirely glabrous; branches pendent, slightly compressed at first, terete with age. Leaves rigidly thick coriaceous, orbicular or broadly elliptic, 5 to 9 cm. long, 4.8 to 7.5 cm. wide, apex broadly rounded or emarginate, short apiculate, base broadly rounded, costa plane above, prominent beneath, lateral veins discernible above, obsolete beneath; petioles stout, 1 to 1.8 cm. long. Inflorescence subspicate-racemose, axillary, solitary, 4.5 to 13 cm. long. Flowers sessile, very fragrant, greenish, in clusters of 3, the clusters short pedicelled. The 3 bracts subtending clusters persistent, broadly ovate, the inner two 2.5 to 2.8 mm. long, the outer one 3.5 to 4 mm. long, acute. Calyx very shallowly dentate. Petals 6, linear, 7 mm. long, acutish. Stamens in 2 series; filaments thick glandular near apex, those of longer stamens free about 0.7 mm., those of shorter stamens adnate to petals nearly to base of anthers. Anthers short apiculate. Style straight, about 5 mm. long.

Type in the Herbarium of the University of Michigan, *C. L. Lundell 6973*, collected in advanced forest at Valentin, El Cayo District, British Honduras, June 27, 1938.

S. belizensis resembles *S. orbicularis* (H.B.K.) Blume superficially, but differs from that species in its much smaller leaves, deciduous bracts, and pedicellate flowers.

***Struthanthus phanerolomus* (Standl.) comb. nov.**

Phthirusa phaneroloma Standl., Carnegie Inst. Wash., Publ. 461:55. 1935.

This well marked species is represented in the Herbarium of the University of Michigan by two specimens of the type collection: *Percy H. Gentle 1426*, a woody parasitic vine on tree overhanging the Sibun River, Belize District, British Honduras, Dec. 5, 1934.

POLYGONACEAE

***COCCOLOBA BROWNIANA* Standl., Trop. Woods 10:4. 1927.**

Coccoloba cardiophylla Standl., Field Mus. Bot. 8:8. 1930, **syn. nov.**

In reducing *C. cardiophylla* to synonymy under *C. Browniana*, types of both, in Field Museum and Yale School of Forestry herbaria respectively, have been compared. The ample material obtained by the 1938 Michigan-Carnegie expedition to Yucatan and Quintana Roo has made possible a better interpretation of the species. *C. Browniana* is known only from the dry uplands of Yucatan, Quintana Roo, northern British Honduras, and Honduras. Its affinities are with *C. Wrecklei* Standl. of Costa Rica and *C. acapulcensis* Standl. of Guerrero, Mexico.

Coccoloba Masoni sp. nov.

Arbor. Ramuli glabri. Folia 5—10 mm. longe petiolata, subcoriacea, obovata vel ovalia, 6—10 cm. longa, 3.3—7 cm. lata, apice rotundata vel late obtusa, basi subcordata vel rotundata, subtus ad costam et in axillis pilosa. Flores dioeci. Inflorescentia ♀ terminalis, spicata, 11.5—15 cm. longa, rachibus puberulis, nodulis 1-floris; bracteae late ovato-triangulares, 1.2—1.5 mm. longae; ochreolae bracteas subaequantes, puberulae; pedicellis nullis vel subnullis. Perianthii tubus puberulus, obconicus, ca. 1 mm. longus, lobis ovatis, 1—1.5 mm. longis, rotundatis. Stamina abortiva. Ovarium trigonum, ellipsoideum, ca. 1.1 mm. longum. Styli 3, exserti.

A large tree; branchlets glabrous. Stipules ample, laxly sheathing, up to 8 mm. long, densely puberulent and barbate at first, glabrescent early, petiole basal. Leaf blades subcoriaceous, obovate or oval, 6 to 10 cm. long, 3.3 to 7 cm. wide, apex rounded or with a broad obtuse point, base subcordate or rounded, uppersurface entirely glabrous, undersurface pilose in the axils and along midrib, the costa and veins puberulent, costa prominent beneath, nearly plane above, primary veins 4 to 6 on each side, prominulous beneath. Petioles sulcate, puberulent, rather stout, 5 to 10 mm. long. Flowers dioecious. Pistillate inflorescence terminal, spicate, 11.5 to 15 cm. long; the rachis densely puberulent; nodules 1-flowered; basal bract up to 5 mm. long, linear-oblongate, upper bracts broadly ovate-triangular, 1.2 to 1.5 mm. long, puberulent outside; ochreolae puberulent, slightly shorter than upper bracts; flowers sessile or nearly so. Perianth tube densely puberulent, thickly obconical, about 1 mm. long; lobes 5, puberulent below, nearly glabrous above, ovate, 1 to 1.5 mm. long, rounded, rather thick, erect. Stamens rudimentary, much shorter than lobes of perianth. Ovary trigonal, ellipsoid, about 1.1 mm. long. Styles 3, exserted.

Type in the Field Museum Herbarium, No. 716278, *H. L. Mason* 1806, collected on Maria Magdalena Island, in the Tres Marias Islands, Mexico, May 21, 1925. Duplicates in the New York Botanical Garden and University of Michigan herbaria.

C. Masoni is related to *C. Schiedeana* Lindau. It is distinct in its puberulent dioecious flowers and obovate or oval leaves pilose in axils and along costa on undersurface.

Coccoloba suborbicularis sp. nov.

Frutex. Ramuli crassi, striati, puberulenti. Folia 1.5—2.3 cm. longe petiolata, subcoriacea, supra glabra, subtus in axillis barbata, costa venisque puberulenta, obovato-orbicularia vel suborbicularia, 14.5—20 cm. longa, 10.7—16.5 cm. lata, apice late rotundata, basi rotundata, inaequalia. Inflorescentia subspicata, pedunculata, usque ad 37.5 cm. longa, rachibus minute puberulis, nodulis 3—4-floris; bracteae deltoideae, 1—1.2 mm.

longae, puberulae; ochreolae bracteis subaequantes. Pedicelli ca. 1 mm. longi. Perianthii tubus 1.3—1.8 mm. longus, lobis ovato-ellipticis vel ellipticis, ca. 2 mm. longis. Filamenta exserta, usque ad 2.8 mm. longa. Styli 3.

A shrub. Branchlets stout, striate, finely puberulent. Stipules sheathing, up to 1.3 cm. long, densely puberulent and barbate, the petiole basal. Leaf blade thinly coriaceous, entirely glabrous above, puberulent beneath along the costa and primary veins, barbate in the vein axils, obovate-orbicular or suborbicular, 14.5 to 20 cm. long, 10.7 to 16.5 cm. wide, apex broadly rounded, base rounded and conspicuously inaequilateral, the costa prominent beneath, nearly plane above, primary veins 5 or 6 on each side, conspicuous on undersurface, prominulous above. Petioles stout, sulcate above, puberulent, 1.5 to 2.3 cm. long. Inflorescence subspicate, pedunculate, up to 37.5 cm. long; rachis minutely puberulent, striate; nodules 3—4-flowered; bracts deltoid, 1 to 1.2 mm. long, obtusish, puberulent; ochreolae subequaling or equaling bracts, puberulent. Pedicels of flowers equaling bracts. Perianth tube broadly obconical, contracted at base, 1.3 to 1.8 mm. long, glabrous; lobes ovate-elliptic or elliptic, up to 2 mm. long, glabrous. Filaments exserted, up to 2.8 mm. long. Ovary possibly abortive. Styles 3.

Type in the Herbarium of the University of Michigan, *Percy H. Gentle* 2687, collected in *acahual* near river bank, 19 Miles, Stann Creek Railway, Stann Creek District, British Honduras, Feb. 15, 1939.

Among the species of the Yucatan Peninsula, *C. suborbicularis* is unique in having the leaf conspicuously unequal at base.

ANONACEAE

***Desmopsis lanceolata* sp. nov.**

Arbor 3—4 m. alta, 15 cm. diam.; ramuli, petioli, pedunculi, et pedicelli novelli adpresse fulvo-hirsuti. Folia membranacea, lanceolata vel lanceolato-elliptica, 5—11.5 cm. longa, 1.6—3.7 cm. lata, apice attenuata, obtusa, basi obtusa vel acutiuscula, supra (nervo medio excepto) glabra, subtus in nervis parce adpresse hirsuta; petiolis crassis, 2—5 mm. longis. Inflorescentiae oppositifoliae, 1-florae; pedunculo 6—8 mm. longo, apice bracteato; pedicellis 7—13 mm. longis. Sepala 4.5—5.5 mm. longa, extus pubescentia. Petala coriacea, lineari-oblonga vel oblanceolato-oblonga, 18—22 mm. longa, 3.5—5 mm. lata, acuta, parce adpresse pubescentia. Carpella 6—9, adpresse hirsuta; ovulis 2.

A small tree, 3 to 4 m. high, 15 cm. diam.; branchlets, petioles, peduncles, and pedicels densely fulvous-hirsute with appressed hairs, glabrescent with age. Leaves membranaceous, lanceolate or lanceolate-elliptic, 5 to 11.5 cm. long, 1.6 to 3.7 cm. wide, apex attenuate, obtuse, base obtuse or acutish, glabrous above except along the costa, rather sparsely appressed hirsute beneath along the costa and veins, glabrescent otherwise, costa

PLATE 3



PLATE 3. *Desmopsis lanceolata* Lundell. Type (*Matuda 2299*) in Herbarium of the University of Michigan. $\times \frac{1}{2}$.

impressed above, prominent beneath, main lateral veins 7 to 11 on each side, prominulous below; petioles stout, 2 to 5 mm. long. Peduncles bearing a solitary flower, opposite the leaves, 6 to 8 mm. long, with several bracts near the apex, these sometimes foliaceous, as much as 12 mm. long; pedicels 7 to 13 mm. long, bearing a small bract near the base. Sepals 3 (sometimes only 2), subequal, lanceolate, 4.5 to 5.5 mm. long, widest at base, pubescent outside. Petals 6 (sometimes 5) yellow (Matuda), equal, linear-oblong or oblanceolate-oblong, 18 to 22 mm. long, 3.5 to 5 mm. wide, usually acute, sparsely appressed pubescent, thick coriaceous, without evident veins. Carpels 6 to 9, brown hirsute; ovules 2.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2299, collected on Mt. Ovando, Chiapas, Mexico, Dec. 1937.

From *D. Galeottiana* (Baill.) Saff., to which it appears nearest, *D. lanceolata* may be readily separated by the undersurface of the leaf which is only sparsely appressed hirsute along the midrib and veins, not hirtellous-tomentose. The long sepals and petals, the 2 ovules in each carpel, the narrow lanceolate leaves, attenuate and obtuse at the apex, and the short pedicels distinguish it further.

CAPPARIDACEAE

Forchammeria Matudai sp. nov.

Arbor 8—10 m. alta, 45 cm. diam., glabra. Folia 2—3-foliolata, raro simplicia; petiolis 2—9.5 cm. longis. Lamina chartacea vel subcoriacea, anguste oblongo-lanceolata, 9—19 cm. longa, 2.2—4.1 cm. lata, apice basique longe attenuato-acuminata. Infructescentia paniculata, laxa, 14—50 cm. longa. Pedicelli fructiferi 3—15 mm. longi. Fructus subglobosus, 8—9 mm. diam.

A tree, 8 to 10 m. high, 45 cm. in diam., glabrous throughout; branchlets rather slender, short, striate, with the leaves aggregated at apex. Leaves 2- to 3-foliolate, rarely simple, petioles of the former 2 to 9.5 cm. long, of the latter 6 to 10 mm. long; blades chartaceous or subcoriaceous, narrowly oblong-lanceolate, widest at or near the middle, 9 to 19 cm. long, 2.2 to 4.1 cm. wide, apex and base long attenuate-acuminate, lateral leaflets inaequilateral, undersurface paler, costa prominent beneath, plane or slightly impressed above, main lateral veins 11 to 14 on each side, patent, prominulous beneath; petiolules 4 to 6 mm. long. Infructescence borne on old wood, openly paniculate, lax, pendent, 14 to 50 cm. long, the peduncle, rachis and branches slender and wiry. Fruiting pedicels slender, 3 to 15 mm. long. Fruit subglobose, 8 to 9 mm. in diam., appearing smooth, obscurely verrucose, usually bearing at base a small rounded protuberance, the abortive second cell of the ovary, rarely with both cells fully developed.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2650, collected on Mt. Ovando, Chiapas, Mexico, Feb. 1939.

Some of the leaves are simple, not unifoliolate. The elongated pendent infructescence, long petioles of the compound leaves, and narrow blades mark the species as distinct from any of the others in the subgenus *Helandra* as delimited by Standley (Journ. Wash. Acad. Sci. 14: 270. 1924). It is related to *F. longifolia* Standl.

LEGUMINOSAE

***Calliandra Matudai* sp. nov.**

Frutex; ramulis, petiolis, rachibus et pedunculis parce albo-villosis, minute rufo-glandulosis. Stipulae subulatae, sericeae, 7—8 mm. longae. Folia 5—10 mm. longe petiolata, pinnis 6- vel 7- raro 5-jugis, foliola 15—28-juga, lineari-oblonga, 3—8.5 mm. longa, 1—2.2 mm. lata, acuta, subcoriacea, adpresse ciliata, costa obsoleta. Inflorescentiae axillares, pedunculis 1.8—2.7 cm. longis. Calyx ca. 2 mm. longus. Corolla ca. 7 mm. longa, lobis parce adpresse villosis. Stamina ca. 2 cm. longa.

A shrub; young twigs rather stout, sparsely white villous and densely red glandular puberulent. Stipules subulate, sericeous, 7 to 8 mm. long; petioles and rachis scantily villous mostly with appressed hairs, red glandular puberulent, petioles 5 to 10 mm. long; pinnae 6 or 7 pairs, rarely only 5 pairs; leaflets 15 to 28 pairs, linear-oblong, 3 to 8.5 mm. long, 1 to 2.2 mm. wide, acute, sessile, inaequilateral at base, subcoriaceous, sparingly appressed ciliate, glabrous otherwise, costa and veins scarcely discernible, the costa nearly central. Peduncles axillary, 1.8 to 2.7 cm. long, sparsely villous, red glandular puberulent. Flowers red. Calyx about 2 mm. long, the teeth villous and red glandular puberulent. Corolla about 7 mm. long, lobes sparsely appressed villous, tube nearly glabrous. Stamens about 2 cm. long, the tube shorter than corolla. Ovary glabrous.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 1888, collected at Buena Vista, Escuintla, Chiapas, Mexico, Jan. 1938.

C. Matudai, which is referable to the section *Microphyllae* of Britton and Rose (N. Amer. Fl. 23:49. 1928), appears closest to *C. nicaraguensis* Taub. & Loes., but may be readily differentiated by its 5 to 7 pairs of pinnae, wider and longer leaflets, villous shorter peduncles, and corolla 7 mm. long.

***Calliandra nogalensis* sp. nov.**

Frutex; ramulis, petiolis, et rachibus dense fulvo-pubescentibus. Stipulae lanceolatae, striatae, 7—8 mm. longae. Folia 2.3—4 cm. longe petiolata, pinnis 5- vel 6-jugis; foliolis 19—30-jugis, lineari-oblongis, 3.5—10 mm. longis, 1.5—2.5 mm. latis, acutiusculis, ciliatis. Inflorescentiae axillares; pedunculis 7.5—9.5 cm. longis, parce pilosis. Calyx ca. 2.5 mm. longus. Corolla glabra, 5—6 mm. longa.

Shrub; branches, petioles, and leaf-rachis densely fulvous pubescent. Stipules lanceolate, striate, pubescent, 7 to 8 mm. long, widest at base;

petioles 2.3 to 4 cm. long; pinnae 5 or 6 pairs, stalked, the rachae short hairy above, pilose below; leaflets 19 to 30 pairs, linear-oblong, 3.5 to 10 mm. long, 1.5 to 2.5 mm. wide, acutish, midvein prominulous, somewhat excentric, ciliate, glabrous otherwise. Peduncles axillary, slender, rather sparsely pilose, 7.5 to 9.5 cm. long. Calyx about 2.5 mm. long, the lobes acute, about 1 mm. long, sparsely ciliate with minute gland-tipped hairs, apices ciliate, glabrous otherwise. Corolla glabrous, 5 to 6 mm. long, lobed to the middle, the lobes recurling. Stamen tube shorter than corolla. Ovary glabrous.

Type in the Herbarium of the University of Michigan, *Eizi Matuda 1153*, collected at Nogales, Vera Cruz, Mexico, May 2, 1937.

C. nogalensis is nearest **Calliandra Spraguei** (Britt. & Rose) Lundell, comb. nov. (*Anneslia Spraguei* Britt. & Rose, N. Amer. Fl. 23:66. 1928) of the section Portoricenses. According to description, *C. Spraguei* has stipules 4 mm. long, pinnae 3 or 4 pairs, leaflets smaller and obtuse, and corolla 3 mm. long, compared with stipules 7 to 8 mm. long, pinnae 5 or 6 pairs, and corolla 5 or 6 mm. long in *C. nogalensis*.

Diphysa macrophylla sp. nov.

Frutex; ramuli glanduloso-hirtelli. Folia 7.5—14 cm. longa. Foliola 7—13, oblonga vel elliptica, 1.5—4.4 cm. longa, 1—2.3 cm. lata, apice basique rotundata. Inflorescentia glanduloso-hirtella, 4—11 cm. longa; pedicellis 6—10 mm. longis. Calycis tubus (hypanthio incluso) ca. 6 mm. longus, glaber, lobis glanduloso-ciliolatis, superioribus 4 mm. longis, prope basin ca. 2.7 mm. latis; inferiore angustiori, ca. 4.5 mm. longo. Corolla ca. 12 mm. longa.

A shrub; branchlets, leaf rachae, racemes, pedicels, and bracts glandular-hirtellous. Leaves 7.5 to 14 cm. long. Leaflets 7 to 13, oblong or elliptic, 1.5 to 4.4 cm. long, 1 to 2.3 cm. wide, rounded at apex and base, paler beneath, sparingly ciliate at first, glabrous otherwise except for a few scattered hairs along the costa beneath; petiolules sparingly short pilose at first, 1.5 to 3 mm. long. Racemes 4 to 11 cm. long. Pedicels 6 to 10 mm. long. Bractlets elliptic, 5 or 6 mm. long. Calyx tube, including hypanthium, about 6 mm. long, glabrous; lobes glandular-ciliate, the two uppermost 4 mm. long, about 2.7 mm. wide at base, rounded or bluntly obtuse at apex, the lower one much narrower, about 4.5 mm. long. Corolla yellow; banner, including claw, about 12 mm. long. Ovary and stipe glandular-hirtellous. Immature pod very sparingly hairy.

Type in the Herbarium of the University of Michigan, *Percy H. Gentle 2317*, collected on river bank at Vaca, El Cayo District, British Honduras, March 10, 1938.

Additional specimen examined: BRITISH HONDURAS. El Cayo District, Vaca, on rock, river bank, April 26, 1938, *Gentle 2523*, flowers.

D. macrophylla, referable to the section *Glanduliferae* (Rydberg, N. Amer. Fl. 24:209. 1924), appears to be very close to *D. humilis* Oerst. of Costa Rica, a species with smaller leaves, fewer and smaller leaflets, shorter racemes, shorter pedicels, and smaller calyx. From *D. Thurberi* and *D. macrocarpa*, which show some relationship also, *D. macrophylla* may be readily separated by its fewer, larger leaflets, not hispidulous-ciliolate.

***Lonchocarpus apricus* sp. nov.**

Arbor, 7 m. alta, 20 cm. diam.; ramulis crassis, minute tomentulosis. Folia 11—19-foliolata, petiolo et rache junctim 9—13.5 cm. longis. Stipulae attenuato-ligulatae, 5—9 mm. longae. Foliola subcoriacea, oblonga vel oblanceolata-obovata, 2—8 cm. longa, 1.2—2.5 cm. lata, apice rotundata, raro late obtusa vel emarginata, basi rotundata, supra puberulenta, subtus dense subadpresse pilosa, reticulato-venosa, costa et nervis impressis et pilosis. Paniculæ pedunculatae, terminales, ex racemis 3—10 cm. longis compositae, rachibus tomentellis. Pedicelli 2.5 mm. longi vel breviores. Calyx campanulatus, adpresse brunneo-hirsutus, 5-dentatus. Petala rubra. Ovarium strigosum, 6-ovulatum.

A tree 7 m. high, 20 cm. in diam.; branchlets stout, minutely tomentellous. Leaves 11- to 19-foliolate, the rachis minutely tomentellous, canaliculate, rachis and petiole together 9 to 13.5 cm. long. Stipules attenuate-ligulate, 5 to 9 mm. long, hairy, deciduous early. Leaflets subcoriaceous; petiolules terete, hairy, 2 to 3.5 mm. long; blades oblong or the terminal oblanceolate-obovate, apex usually rounded, sometimes bluntly obtuse or slightly emarginate, base rounded, 2 to 8 cm. long, 1.2 to 2.5 cm. wide, uppersurface puberulent, short pilose along costa and veins, undersurface densely pilose with subappressed whitish hairs, primary veins 9 to 17 on each side, approximate, the costa and veins deeply impressed above, prominent beneath, veinlets finely reticulate. Racemes numerous, crowded in panicles at ends of branchlets, 3 to 10 cm. long, the rachis tomentellous. Peduncles and pedicels minutely tomentellous, the latter up to 2.5 mm. long. Calyx companulate, densely covered with short appressed brownish hairs, 5-toothed, the carinal tooth acuminate, longest, the 2 vexillar teeth united, deltoid, minutely bidentate at apex. Petals reddish (Matuda); standard broadly ovate-orbicular, apex slightly emarginate, base subtruncate and minutely bilobate, the lobes hairy, the claw about 1 mm. long, the blade 6 to 7 mm. long, 8 to 8.5 mm. wide, densely golden strigose outside; wings 8 mm. long, including claw 2.5 mm. long, auriculate, the auricle and base of blade on carinal side ciliate; carinal petals 7.5 mm. long, auriculate, the auricle ciliate, golden strigose above and along carinal margin, glabrous below. Anthers and free part of filaments sometimes bearing a few hairs. Ovary strigose, linear, 6-ovulate; style curved, slightly exceeding stamens, glabrous above, with a few hairs at base. Legume unknown.

PLATE 4



PLATE 4. *Lonchocarpus apricus* Lundell. Type (*Matuda S-197*) in Herbarium of the University of Michigan. $\times \frac{1}{2}$.

Type in the Herbarium of the University of Michigan, *Eizi Matuda S-197*, collected at Finca Esperanza, Escuintla, Chiapas, Mexico, July 3, 1937.

Additional specimens examined: MEXICO: Chiapas, Escuintla, Finca Esperanza, July 9, 1937, *Matuda 1788*. Escuintla, a tree of open sunny places, alt. 160 m., July 1938, *Matuda 2620*.

L. apricus, referable to the section *Philenopteri* of Pittier (Contrib. U. S. Nat. Herb. 20:44. 1917), bears a close resemblance to *L. rugosus* Benth. and *L. Hintoni* Sandwith, but it may be readily separated from both by the numerous approximate lateral veins of the leaflets. Differences in pubescence, flower size, number of ovules, and leaf form distinguish the species further. Since *L. rugosus* was described from Campeche, I have interpreted recent collections, *Lundell 857* and *1319* from Tuxpeña in that state, as representative of the species. It is possible that some of the specimens referred by Pittier (l.c.) to *L. rugosus* belong to *L. apricus*.

***Lonchocarpus orizabensis* nom. nov.**

Lonchocarpus affinis Pittier, Contrib. U. S. Nat. Herb. 20:56. 1917, non *Lonchocarpus affinis* De Willd., Ann. Mus. Congo, Ser. IV. 196. 1902-1903.

PITHECOLOBIUM ALBICANS (Kunth) Benth., Trans. Linn. Soc. Bot. 30: 592. 1875.

Albizzia rubiginosa Standl., Carnegie Inst. Wash., Publ. 461:58. 1935, non Miquel, 1855.

Albizzia Lundellii Standl., Trop. Woods 52:26. 1937, **syn. nov.**

Albizzia Lundellii differs in no particular from *Pithecolobium albicans*, and must be reduced to synonymy. In reaching this conclusion, the type collection, *Lundell 866*, has been compared with the ample material of *P. albicans* in the Herbarium of the University of Michigan.

RUTACEAE

***Zanthoxylum Gentlei* sp. nov.**

Arbor 25 cm. diam., glabra; ramulis inermibus. Folia 2.5—5 cm. longe petiolata, imparipinnata; foliola 9—15, opposita, lanceolato-oblonga, anguste elliptico-oblonga vel oblanceolato-oblonga, 4—10.5 cm. longa, 1.2—3 cm. lata, apice attenuato-acuminata, acumine obtuso, basi acuta vel anguste rotundata, crenata; petiolulis 2.5—5.5 mm. longis. Infructescencia paniculata, compacta, 9 cm. longa vel minor. Sepala 5, imbricata, late rotundata. Follicula 1—5, obovoidea, 5—6 mm. longa, stipitata.

A tree 25 cm. in diam., entirely glabrous; branchlets stout, unarmed, drying black. Petiole and rachis unarmed, narrowly canaliculate above, the former 2.5 to 5 cm. long, the latter 5.5 to 11 cm. long. Leaflets 9 to 15, opposite, lanceolate-oblong, narrowly elliptic-oblong to oblanceolate-oblong, 4 to 10.5 cm. long, 1.2 to 3 cm. wide, apex attenuate-acuminate, the acumen obtuse with a slight notch, base acute to narrowed and rounded, usually inaequilateral, conspicuously crenate, dull, chartaceous, main

lateral veins 8 to 11 on each side, patent, prominulous beneath, costa impressed above, prominent on undersurface; petiolules 2.5 to 5.5 mm. long. Infructescence evidently terminal, panicles rather compact, up to 9 cm. long, and nearly as wide, the branches corky-thickened and scaly. Fruiting pedicels stout. Persistent sepals 5, imbricate, broadly rounded. Follicles 1 to 5, obovoid, 5 to 6 mm. long, glandular, drying black, stipitate, the stipe 2 to 4 mm. long, stout. Seeds black, 4 to 5 mm. long.

Type in the Herbarium of the University of Michigan, *Percy H. Gentle* 2652, collected in broken ridge, Stann Creek-Mullin's River road, Stann Creek District, British Honduras, Sept. 10, 1938; vernacular name "*prickly yellow*."

Although *Z. Gentlei* is closely related to *Z. caribaeum* Lam., its aspect is quite different. It may be recognized easily by the unarmed branchlets and long slender attenuate-acuminate leaflets.

MELIACEAE

Guarea Matudai sp. nov.

Arbor, 12 m. alta, 35 cm. diam., ramulis, petiolis, et rachibus novellis parce strigillosis. Folia magna, 4.5—6.5 cm. longe petiolata, rachibus 4—20 cm. longis. Foliola 4—12, opposita, chartacea vel subcoriacea, elliptica, oblongo-elliptica vel oblanceolato-elliptica, 12.5—23.5 cm. longa, 6—10.5 cm. lata, apice abrupte et breviter acuminata (acumine late obtuso), basi acutiuscula, inaequilateralia, reticulata, bullata; petioluli 4—8 mm. longi. Paniculae 19 cm. longae, 14 cm. latae, vel minores, novellis strigillosis. Pedicelli 1—3 mm. longi, strigillosi. Calyx parce strigillosus, 2—3.5 mm. longe stipitatus, 4- raro 3-lobatus, lobis ca. 2.5 mm. longis. Petala lanceolato-oblonga vel oblonga, 8—9.5 mm. longa, 2.7—4.4. mm. lata, acutiuscula. Stamina 8. Filamenta in tubum cylindricum 6—7.5 mm. longum connata, glabra. Ovarium glabrum.

A tree 35 cm. in diam., 12 m. high; branchlets, petioles, leaf rachis and branches of inflorescence sparsely short strigillose at first, glabrescent with age. Leaves large; petioles 4.5 to 6.5 cm. long; rachis 4 to 20 cm. long, shallowly grooved. Leaflets 4 to 12, opposite, chartaceous to subcoriaceous, sometimes with a few short appressed hairs beneath at base especially on costa, usually entirely glabrous, elliptic, oblong-elliptic or oblanceolate-elliptic, 12.5 to 23.5 cm. long, 6 to 10.5 cm. wide, apex abruptly short acuminate, the acumen bluntly obtuse, base acutish, inaequilateral, strongly reticulate veined on both sides, bullate, costa and primary veins impressed above, prominent beneath, the costa quite thick, main lateral veins 10 to 15 on each side, strongly and arcuately ascending, extending to the margin; petiolules stout, 4 to 8 mm. long, strigillose. Panicle large, openly branched from base, up to 19 cm. long, 14 cm. wide. Pedicels densely strigillose, 1 to 3 mm. long. Calyx sparsely strigillose, contracted

abruptly at base into a stipe 2 to 3.5 mm. long, usually 4-lobed, sometimes 3 lobed, the lobes broad, subtruncate, slightly apiculate, about 2.5 mm. long. Petals lanceolate-oblong or oblong, 8 to 9.5 mm. long, 2.7 to 4.4 mm. wide, acutish, apex minutely papillate, in aestivation valvate. Staminal tube cylindric, thick, glabrous, 6 to 7.5 mm. long, slightly crenate; anthers 8. Ovary 4 celled, glabrous, raised on a short gynophore, ovoid, with an annular disk at base; stigma discoid, large.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2440, collected on Mt. Tacana, Chiapas, Mexico, Aug. 1938; alt. 1000—2000 m.

G. Matudai is near *G. erythrocarpa* C.DC. of Costa Rica which has petals 12 mm. long and 2 mm. wide compared with petals 8 to 9.5 mm. long and 2.7 to 4.4 mm. wide in *G. Matudai*. This important difference in the flowers, the bullate and elliptic leaflets, the type of pubescence, the length of pedicels, and the abrupt prolongation of the calyx base into a conspicuous stripe are distinguishing characteristics.

GUAREA TROMPILLO C.DC., Ann. Cons. Jard. Geneve **10**: 147. 1907.

This species, recorded previously only from the type locality in Guatemala, occurs in Mexico. *Eizi Matuda* 2616, a tree 10 m. high, 45 to 60 cm. in diam., collected at Escuintla, Chiapas, July 1938; alt. 160 m.; vernacular name "*trompillo*." It is very close to *G. Chicon* C.DC.

***Trichilia Matudai* sp. nov.**

Arbor, 13 m. alta, 27 cm. diam. Folia 35—45 cm. longa, 3.5—4.5 cm. longe petiolata. Foliola 16, alterna, oblonga vel oblanceolata, 5—18.5 cm. longa, 3—5.3 cm. lata, apice acuminata vel subacuminata, basi acuta, inaequilateralia, utrinque parce strigillosa; petioluli 2—5 mm. longi. Paniculae pedunculatae, axillares, 12.5—31 cm. longae, strigillosae et puberulentae. Pedicelli 2—3 mm. longi. Calyx 5-lobatus, extus strigillosus. Corolla ca. 4 mm. longa, extus strigillosa, 5-lobata, lobis ovato-triangularibus, acutiusculis. Stamina 16. Filamenta ad apicem in tubum 2—2.7 mm. longum connata, extus parce pilosa, intus sub apice pilosa. Antherae sessiles vel subsessiles. Ovarium hirsutum.

A tree 27 cm. in diam., 13 m. high; branchlets covered with close brown tomentum and short appressed hairs. Leaves even-pinnate, 35 to 45 cm. long; petioles stout, 3.5 to 4.5 cm. long, the petiole and leaf rachis sulcate, strigillose and puberulent. Leaflets 16, alternate, the lateral oblong, the terminal oblanceolate, basal reduced, 5 to 7.5 cm. long, 3 to 3.5 cm. wide, upper lateral 10 to 18.5 cm. long, 3.5 to 5.3 cm. wide, terminal 7 to 9 cm. long, apex acuminate or subacuminate, base strongly inaequilateral and acute, costa prominent beneath, slightly impressed above, main lateral veins 12 to 22 on each side, nearly horizontal, arcuate, anastomosing submarginally, veinlets openly reticulate, veins and veinlets prominulous on

PLATE 5



PLATE 5. *Trichilia Matudai* LAMOUR. Type (Matuda 2531) in Herbarium of the University of Michigan. $\times \frac{1}{2}$

both surfaces, sparingly strigillose on both surfaces, the hairs subappressed, costa puberulent at base beneath; petiolules canaliculate, 2 to 5 mm. long, strigillose and puberulent. Panicles very large, axillary, 12.5 to 31 cm. long, up to 14 cm. wide, often subequalling leaves, openly branched; peduncles 2 to 8.5 cm. long, the peduncles and branches strigillose and puberulent. Pedicels 2 to 3 mm. long, rarely longer, jointed at or above middle, strigillose and puberulent. Calyx strigillose outside, shallowly 5-lobed, the lobes broadly rounded, subtruncate. Corolla strigillose outside, about 4 mm. long, 5-lobed to the middle, the lobes valvate, ovate-triangular, acutish. Stamens 10, the filaments united to the apex forming a tube 2 to 2.7 mm. long with apical filiform teeth subequalling anthers, sparsely long pilose outside, densely long pilose above within; anthers sessile or nearly so, inserted at base of sinuses, oblong, about 1 mm. long, bluntly obtuse, glabrous. Ovary depressed ovoid, densely short hirsute, 3-celled with 2 collateral ovules in each cell; style glabrous above; stigma capitate. Fruits unknown.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2531, collected on Mt. Madre Vieja, Chiapas, Mexico, June 1938; alt. 1000 m.

The exceptionally large panicles mark the species. Its affinity is with *T. moschata* Sw. of Jamaica.

EUPHORBIACEAE

PHYLLANTHUS ANTILLANUS (Adr. Jussieu) Muell. Arg., *Linnaea* 32: 51. 1863.

Phyllanthus nobilis (L.f.) Muell. Arg., DC. Prod. 15: 414. 1866, nomen confusum.

Celastrus tetramerus Standl., Contrib. U. S. Nat. Herb. 23: 679. 1923, **syn. nov.**

The type of *Celastrus tetramerus* Standl., *Pringle* 10319 (U. S. Nat. Herb. No. 462573), differs in no way from the glabrous form of *Phyllanthus nobilis*. According to L. C. Wheeler (Contr. Gray Herb. 124: 35. 1939), the name *P. nobilis* should be abandoned under Article 64 of the International Rules. The name *P. antillanus* is revived for the plant.

SPECIES OF SEBASTIANIA IN THE YUCATAN PENINSULA

The genus is represented in the peninsula by three endemic species: *S. adenophora* Pax & Hoffm., *S. Standleyana* Lundell, and *S. confusa* Lundell. All are locally noted for their poisonous white latex. The potency of the poison does not appear to be as great as in *Metopium Brownei* (Jacq.) Urban, a relative of poison ivy common in the region, yet the latex causes painful blisters wherever it comes into contact with the skin. Certain Mexican sebastianias are well known for their fruit which furnishes the famous "jumping beans."

KEY TO THE SPECIES

- Bracts of staminate flowers stalked; basal serratures of leaf blade not glandular 1. *S. adenophora*
 Bracts of staminate flowers sessile; basal serratures of leaf blade glandular
 Leaf blades long-cuspidate; staminate flowers 6 to 9 in each bract; stamens 2 to 6; capsules
 8 to 11 mm. long, 10 to 13 mm. wide. 2. *S. Standleyana*
 Leaf blades not cuspidate, the acumen usually short, obtuse to acutish; staminate flowers 3
 in each bract; stamens 2 or 3; capsules not over 6 mm. long, 10 mm. wide. 3. *S. confusa*

1. *SEBASTIANIA ADENOPHORA* Pax & Hoffm., Engl. Pflanzenreich IV.
 147⁵: 145. 1912.

A small glabrous tree 5 to 7 m. high, 7.5 to 10 cm. in diam. Leaves thin, lanceolate, ovate, oblong, or elliptic-oblong, 3 to 8.3 cm. long, 1.5 to 3.1 cm. wide, apex usually acuminate with the acumen acute to obtusish, sometimes acute or obtuse, base obtuse or rounded, biglandular and revolute, margin minutely serrulate; stipules deciduous early, setulose-subulate; petioles 3 to 5.5 mm. long. Spikes terminal, bisexual, 3 to 5.5 cm. long, slender, with 1 to 3 pistillate flowers at base; ovary glabrous. Staminate flowers usually 5 in each bract, the bracts short stalked, with glands on each side at apex of stalk; sepals subulate, lanceolate, or ovate; stamens usually 2, sometimes as many as 5. Capsules smooth, 5 to 6 mm. long, 6 to 7 mm. wide.

Specimens examined: MEXICO: Yucatan, Silam, *G. F. Gaumer 615*, type collection. Suitun, May 1916, *Gaumer and Sons 23293*. Yucatan in 1937, *Morris Steggerda 32c*. Chichen Itza, around Sacred Cenote, June 12, 1938, *C. L. Lundell and Amelia A. Lundell 7526*. Quintana Roo, Chichan-kanaab, *Gaumer 1870*. BRITISH HONDURAS: Orange Walk District, Honey Camp, Sept. 1929, *C. L. Lundell 434*.

Distribution: Endemic in the drier areas of the Yucatan Peninsula; collected in Yucatan, Quintana Roo, and northern British Honduras. Although reported by Gaumer to be generally distributed over the State of Yucatan, the species was encountered only once by the writer in 1938 during intensive explorations through Yucatan and eastward to Coba, Quintana Roo.²

Vernacular names: "*chechem blanco*" (*Lundell and Lundell 7526*); "*sac-che-chem*" (*Steggerda 32c*).

2. *Sebastiania Standleyana* sp. nov.

Sebastiania longicuspis Standl., Field Mus. Bot. 11: 134. 1932, nomen confusum.

Arbor glabra, 40 m. alta, 45 cm. diam. Folia membranacea, oblonga vel oblanceolata, 7.5—14 cm. longa, 2.3—4 cm. lata, apice abrupte cuspidata, basi obtusa, obscure serrulata; petiolis 7—15 mm. longis. Spicae terminales, usque ad 12.5 cm. longae. Bractee masculae sessiles, basi

² Lundell, C. L. The 1938 Botanical Expedition to Yucatan and Quintana Roo, Mexico. Carnegie Inst. Wash., Year Book No. 37: 143—147. 1938.

utrinque glandula auctae, 6—9-florae. Stamina 2—6. Capsula glabra, 8—11 mm. longa, 10—13 mm. lata. Semina subglobosa, ca. 3.5 mm. diam., 4 mm. longa.

A graceful tree up to 40 m. high and 45 cm. in diam., entirely glabrous; trunk straight, bark smooth, gray. Leaves thin, oblong or oblanceolate, 7.5 to 14 cm. long, 2.3 to 4 cm. wide, apex abruptly long-cuspidate, base obtuse, veins prominulous on both surfaces, reticulate, obscurely serrulate, the basal serratures glandular; petioles slender, 7 to 15 mm. long. Spikes terminal, as much as 12.5 cm. long, rather stout, bisexual, with 1 or 2 pistillate flowers at base, ovary glabrous, subsessile. Staminate flowers 6 to 9 in each bract, crowded, the bracts sessile, lunate, very short, erose, with large flat sessile glands at base on each side; calyx cupular, laciniatedentate, stamens 2 to 6. Capsule smooth, 3-celled, 8 to 11 mm. long, 10 to 13 mm. wide. Seed subglobose, about 3.5 mm. in diam., 4 mm. long.

Type in the Herbarium of the University of Michigan, *Percy H. Gentle 2544*, collected on hillside opposite Vaca, El Cayo District, British Honduras, May 1, 1938.

Additional specimens examined: BRITISH HONDURAS: Toledo District, Punta Gorda, "El dorado," Sept. 17, 1932, *W. A. Schipp 1018*, type of *S. longicuspis* Standl. Rio Grande, April 21, 1933, *Schipp 1165*. El Cayo District: Vaca, 1927, *Duncan Stevenson 2* (Yale 11985). El Cayo, June 25, 1933, *C. L. Lundell 4435*. Monkey Falls, Aug. 15, 1936, *Lundell 6973*. Vaca, March 11, 1938, *Percy H. Gentle 2329*. GUATEMALA: Department of Petén, Uaxactun, Mar. 20, 1931, *H. H. Barilett 12152*; April 24, 1931, *Barilett 12731*. La Libertad, May 31, 1933, *Lundell 3520*. Yaxmoxan, on Yaxha-Remate road, June 16, 1933, *Lundell 4304*. Department of Alta Verapaz, Cubilquitz, *H. von Tuerckheim 8658*.

Distribution: Endemic in central and southern British Honduras and adjacent Guatemala. The tree is often found in dense stands in second growth as well as advanced forest. It grows in wet soils and dry uplands, having been collected on *aguada* banks, river banks, in wet depressions, and on dry hillsides. Along the Arenal-Valentin trail south from El Cayo at the mahogany camp called Esperanza, a grove was encountered in a wet cohune ridge.

Vernacular names: "reventadillo" (*Lundell 4435*); "chechem blanco" (*Lundell 3520, 4304, 6973; Barilett 12152*); "white poison" (*Gentle 2544*); "icichek" (*Barilett 12152*); "poison wood" (*Schipp 1165*); "ridge white poison wood" (*Stevenson 2*).

The type of *Sebastiania longicuspis* Standl. (*Schipp 1018*) consists of two entirely discordant elements, a sterile leafy branch of *Sebastiania Standleyana* and loose drupaceous fruits which belong to some unidentified species not of this genus. Standley, in the original description and subsequently (*Field Mus. Bot. 12:224. 1936*), described *S. longicuspis* as having "drupe-like, globose" fruits, and expressed doubt concerning the generic position of the species because of the fruits. According to Art. 64 of the International Rules, the name must be rejected. The writer hesi-

tates to rename and redescribe the species, but does so to avoid further confusion.

3. ***Sebastiania confusa*** sp. nov.

Arbor glabra, 5 m. alta. Folia membranacea, oblonga vel elliptica, 4.5—11 cm. longa, 2.2—3.5 cm. lata, apice acuminata, acumine obtuso vel acutiusculo, basi obtusa vel rotundata, serrulata; petiolis 3.5—7 mm. longis. Spicae terminales, usque ad 7 cm. longae. Bractae masculae sessiles, late ovatae, lacinulatae, basi utrinque glandula oblonga auctae, 3-florae. Sepala ovata. Stamina 3, raro 2. Capsula glabra, parva, ca. 6 mm. longa, 10 mm. lata, vel minor. Semina globosa, ca. 3 mm. diam.

A glabrous tree 5 m. high; branchlets slender. Leaves thin, oblong or elliptic, 4.5 to 11 cm. long, 2.2 to 3.5 cm. wide, apex acuminate, the acumen obtuse to acutish, base obtuse or rounded, minutely emarginate above, finely serrulate, the basal serratures glandular, costa prominulous on both surfaces, main lateral veins 10 to 14 on each side, veins and veinlets fine, discernible on both surfaces; stipules small, ovate, lacinulate; petioles slender, 3.5 to 7 mm. long. Spikes terminal, up to 7 cm. long (apparently bisexual with 1 to 3 pistillate flowers at base); bracts of staminate flowers sessile, broadly ovate, lacinulate, with a flat oblong peltate gland at base on each side, 3-flowered; the flowers pedicellate with the central pedicel longest. Sepals of staminate flowers 3, equal or nearly so, ovate, united at base, erose. Stamens usually 3, sometimes 2. Capsules smooth, as much as 6 mm. long and 10 mm. wide. Seed globose, about 3 mm. in diam.

Type in the Herbarium of the University of Michigan, *C. L. Lundell 4119*, collected near Big Fall, Belize River, Belize District, British Honduras, June 14, 1933.

Additional specimens examined: BRITISH HONDURAS: Belize District, Jones Bank, Belize River, June 1933, *Lundell 4130*. St. James' Boom, on bank of Belize River, June 13, 1936, *Lundell 6092*. GUATEMALA: Department of Petén, El Paso, April 28, 1932, *Lundell 1607*.

Distribution: Endemic in northern and central British Honduras, and northern Petén, Guatemala. It is an infrequent species collected only in secondary forest.

Vernacular name: "white poison wood" (*Lundell 6092*).

The flowering material is fragmentary, which accounts for the incomplete description. Although collections of *S. confusa* have been referred to *S. adenophora*, which bears a superficial resemblance, the species is more closely related to *S. Standleyana*. Differences noted in the key readily distinguish it from both.

CELASTRACEAE

Celastrus Mainsiana sp. nov.

Frutex scandens, 50-metralis, 5 cm. diam. Folia subcoriacea, ovato-oblonga vel ovato-elliptica, 6.5—9.7 cm. longa, 3—4.6 cm. lata, apice

acuminata, acumine obtusiusculo, basi rotundata et abrupte acutiuscula, crenulato-serrulata, nervis lateralibus utrinque 7—9, prominulis; petiolo 6—7 mm. longo. Infructescentiae paniculatae, axillares, 2.5—3 cm. longae; pedicellis 3.5—4 mm. longis. Capsula monosperma, late obovoidea, 8—12 mm. longa (immatura).

A woody vine 50 m. high, 5 cm. in diam., entirely glabrous. Leaves subcoriaceous, ovate-oblong or ovate-elliptic, 6.5 to 9.7 cm. long, 3 to 4.6 cm. wide, apex acuminate, the acumen obtusish, base rounded and abruptly acutish, crenulate-serrulate, the crenatures crowned with minute blackish teeth, costa elevated on both surfaces, main lateral veins 7 to 9 on each side, prominulous beneath, less conspicuous above, veinlets reticulate; petioles canaliculate, 6 to 7 mm. long. Infructescence paniculate, axillary, 2.5 to 3 cm. long; fruiting pedicels 3.5 to 4 mm. long, jointed at or near the base. Persistent calyx deeply 5-lobed, the lobes ovate-deltoid, about 1 mm. long, rounded. Filaments subulate, about 0.9 mm. long. Anthers cordate, 0.5 mm. long, rounded. Immature capsules broadly obovoid, 8 to 12 mm. long, 3-celled, with 1 erect ovule in each cell, 1-seeded.

Type in the Herbarium of the University of Michigan, *C. L. Lundell* 6307, collected in high advanced forest of limestone valley along Valentin-Retiro road, El Cayo District, British Honduras, June 30, 1936.

C. Mainsiana is near *C. vulcanicolus* Donn. Sm. of Guatemala. The writer takes pleasure in naming the species for Dr. E. B. Mains, companion on the 1936 expedition to British Honduras.

***Elaeodendron trichotomum* (Turcz.) comb. nov.**

Maytenus trichotomus Turcz., Bull. Soc. Nat. Moscou 31:451. 1858.

My conclusion that this species is referable to *Elaeodendron* is based on a study of the type photograph in the Michigan collection and a fragment of type material in the Field Museum Herbarium (No. 679123). *J. G. Ortega* 6842 from Bellavista, Mazatlan, Sinaloa, Mexico is referable here.

***Euonymus enantiophyllus* (Donn. Sm.) comb. nov.**

Maytenus enantiophyllus Donn. Sm., Bot. Gaz. 55:432. 1913.

Although no specimens of *E. acuminatus* Benth., described from Oaxaca, have been seen, *E. enantiophyllus* must be very close to that species. Bentham described his plant as having smooth branches and verrucose immature capsules; in *E. enantiophyllus* the branches are conspicuously angled and the fruits are smooth. Skutch's collections have somewhat wider leaves and larger flowers than the type. I have examined the type, *Heyde and Lux* (Donn. Smith 3087), in the U. S. National Herbarium, and *A. F. Skutch* 327 and 637, all from Guatemala.

Zinowiewia tacanensis sp. nov.

Arbor 7 m. alta, 15—17 cm. diam. Folia 4—6 mm. longe petiolata, submembranacea vel chartacea, lanceolata vel lanceolato-oblonga, 4.5—7.5 cm. longa, 1.5—2.7 cm. lata, apice attenuata, late obtusa vel obtusorotundata, raro rotundata, basi rotundata et acutiuscula. Cymae 1—2.7 cm. longae. Calyx profunde quinquefidus, lobis ca. 0.5 mm. longis, ca. 0.65 mm. latis. Petala 5, ovata, 1.1—1.3 mm. longa. Filamenta 0.4—0.5 mm. longa. Ovarium in discum subimmersum.

A glabrous tree 7 m. high, 15 to 17 cm. in diam.; branchlets slender, drying reddish-black, compressed at the nodes. Leaves thin, submembranous to chartaceous, drying dull green, concolorous. Petioles slender, 4 to 6 mm. long, canaliculate. Leaf blades lanceolate or lanceolate-oblong, 4.5 to 7.5 cm. long, 1.5 to 2.7 cm. wide, apex usually attenuate-acuminate, the point bluntly obtuse or obtuse-rounded, sometimes rounded, base rounded and slightly decurrent, acutish, costa elevated above as a fine narrow ridge, prominent beneath, main lateral veins 6 to 9 on each side, patent, nearly horizontal, anastomosing at the margin, prominulous on both surfaces, the veinlets openly reticulate. Cymes 1 to 2.7 cm. long, subsessile or short pedunculate, forked 4- to 6-times, the branches short, crowding the flowers. Flowers short stipitate, the terminal pedicelled, the lateral sessile. Calyx abruptly contracted at base into a stipe 0.2 to 0.35 mm. long, 5-lobed, the lobes depressed ovate-triangular, obtusish, about 0.5 mm. long, 0.65 mm. wide. Petals 5, ovate, 1.1 to 1.3 mm. long, apex obtuse-rounded, 1-nerved. Filaments subulate, 0.4 to 0.5 mm. long. Anthers minute. Disk thick, pentagonal. Ovary submerged in disk or nearly so. Style conical, equaling filaments. Ovary 2-celled, with 2 erect collateral ovules in each cell. Young immature fruits samaroid, typical of genus.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2455, collected on Mt. Tacana, Chiapas, Mexico, Aug. 1938; alt. 1000—2000 m.

Z. tacanensis is nearest *Z. Matudai*. In the former the petioles are 4 to 6 mm. long, compared with 7 to 11 mm. in *Z. Matudai*; the apex of the leaf blade is bluntly obtuse or rounded, rather than obtusish or acute; the base of the blade is not revolute or callosed; the lateral veins are nearly horizontal, not strongly ascending; and the flowers are smaller, the petals being only 1.1 to 1.3 mm. long.

It is evident that the species of *Zinowiewia* are very localized, a condition true in other genera of the same family.

ICACINACEAE

OECOPETALUM MEXICANUM Greenm. & Thomps., Ann. Mo. Bot. Gard. 1: 408. 1914.

The range of this monotypic genus, described from Veracruz, is con-

siderably extended by the following collection: *Eizi Matuda* 2437, a tree 8 m. high, 30 cm. in diam., collected at edge of virgin forest on Mt. Tacana, Chiapas, Mexico, Aug. 1938; alt. 1000–2000 m. The specimens agree with the plate and original description of the species with one exception; the flowers have two suspended ovules in the one-celled ovary, whereas Greenman and Thompson described the ovary as uniovulate.

BOMBACACEAE

***Hampea macrocarpa* sp. nov.**

Arbor. Ramuli glabri. Folia 4–13.5 cm. longe petiolata, glabra, chartacea, late rotundato-ovata, 8.5–15.5 cm. longa, 7.3–13.3 cm. lata, apice abrupte acuminata, basi cordata, 7-nervia. Pedunculus crassus, glaber, 2.5–2.9 cm. longus. Capsula 3-valvata, oblongo-ellipsoidea, 3.2–4 cm. longa, intus glabra, extus minute tomentosa, flavida.

A tree; branchlets rather slender, glabrous. Petioles slender, 4 to 13.5 cm. long, glabrous. Leaf blades with a few scattered hairs on veins beneath at first, glabrous early, chartaceous, broadly rounded-ovate, 8.5 to 15.5 cm. long, 7.3 to 13.3 cm. wide, apex abruptly acuminate, the acumen broad at base, acutish, base deeply cordate, paler beneath, entire, 7-veined, the veins prominent on undersurface. Fruiting peduncles axillary, stout, glabrous, 2.5 to 2.9 cm. long. Persistent calyx glabrous, 8 to 9 mm. long, irregularly lobed. Capsules 3-valvate, oblong-ellipsoid, 3.2 to 4 cm. long, rounded at apex, glabrous within, covered outside with dense yellowish tomentum; seeds usually 6 in each cell, 6.5 to 7.5 mm. long, reddish-black, arillate.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2676, collected at Las Garzas, Acapet., Chiapas, Mexico, Jan. 1939.

From *H. Roxirosae* Standl., which bears a close resemblance according to description, *H. macrocarpa* may be separated by its deeply cordate entire leaves. Fruits of *H. Roxirosae* apparently are not known.

GUTTIFERAE

***Clusia Chanekiana* sp. nov.**

Fig. 2

Frutex hemi-epiphyticus, glaber, 4-metralis. Folia coriacea, oblanceolato-oblonga vel obovato-elliptica, 12.5–22 cm. longa, 4.3–9.3 cm. lata, apice late rotundata, basi cuneata, costa supra subplana subtus prominente crassa, nervis lateralibus 20–20, utrinque prominentibus valde obliquis angulo acutissimo adscendentibus; petiolis 1.3–2.5 cm. longis. Inflorescentiae terminales, 1- vel 3-florae. Pedunculus crassus, 2–3 cm. longus. Pedicellis 1.5–2.5 cm. longis. Bracteae calycinae 4, latissime

ovatae, 3.5—6 mm. longae. Sepala 4, late ovata, ca. 15 mm. longa, rotundata. Capsula oblongo-ellipsoidea, 12 cm. longa, 4.5 cm. lata, 6-locularis.

A woody hemi-epiphyte 4 m. high; branchlets thick, hanging down from weight of fruits. Leaves coriaceous, oblanceolate-oblong or obovate-elliptic, 12.5 to 22 cm. long, 4.3 to 9.3 cm. wide, apex broadly rounded, base cuneate, costa prominent beneath, nearly plane above, main lateral veins 20 to 26 on each side, very oblique and strongly ascending, prominent



Fig. 2. *Clusia Chanekiana* Lundell. Fruits from type plant. $\times \frac{1}{2}$.

on both surfaces; petioles stout, 1.3 to 2.5 cm. long, not winged. Peduncles thick, 2 to 3 cm. long, terminal, solitary or bearing 3-fruits; pedicels thick, 1.5 to 2.5 cm. long, bearing 4 or 6 bracteoles, 4 of which subtend the persistent calyx, bracteoles depressed ovate, 3.5 to 6 mm. long. Sepals 4, subequal, broadly ovate, about 15 mm. long, rounded at apex. Capsule yellowish-white, often tinged rose-red on side, oblong-ellipsoid, up to 12 cm. long and 4.5 cm. in diam.; 6-celled; the pulp surrounding seed orange-red; persistent stigmas 6, tuberculate (see Fig. 2).

Type in the Herbarium of the University of Michigan, *C. L. Lundell*

6366, collected on tree in advanced forest at Valentin, El Cayo District, British Honduras, July 3, 1938; vernacular name "*chunup*."

C. Chanekiana, named for Mercedes Chanek, our Maya assistant on the 1936 expedition, is a close relative of *C. Lundellii* Standl. which occurs in the same locality. The latter species has capsules only about one-third as large and smaller leaves not as broadly rounded at apex.

FLACOURTIACEAE

Casearia Bartlettii sp. nov.

Arbor, 20 cm. diam. Ramuli glabri. Folia 7—12 mm. longe petiolata, subcoriacea, glabra, oblongo-oblancheolata, 8—14.5 cm. longa, 2.6—4.6 cm. lata, apice abrupte acuminata (acumine obtusiusculo), basi acuta, integra vel obscure crenulata, reticulata. Flores fasciculati. Pedicelli 4—6 mm. longi, puberuli. Sepala 5, basi connata, oblongo-oblancheolata, ca. 12 mm. longa, 4—5.5 mm. lata, utrinque tomentulosa. Stamina 10—12. Filamenta in tubum 6—7 mm. longum connata, apice libera. Ovarium et stylum pilosum.

A tree 20 cm. in diam. with smooth, gray bark; branchlets slender, entirely glabrous. Leaves subcoriaceous with age, entirely glabrous; stipules broadly triangular, minute, persistent; petioles slender, 7 to 12 mm. long; blades oblong-oblancheolate, 8 to 14.5 cm. long, 2.6 to 4.6 cm. wide, apex rather abruptly acuminate, the acumen obtusish, base acute, margin entire or very obscurely crenate, prominently reticulate-veined on both surfaces, the main lateral veins 9 to 11 on each side. Flowers fasciculate in the axils, large, white; pedicels jointed at base, puberulent, 4 to 6 mm. long. Sepals 5, petal-like, united at base, oblong-oblancheolate, about 12 mm. long, 4 to 5.5 mm. wide, puberulent or finely tomentulose on both surfaces. Stamens 10 to 12, alternating with staminodia; filaments united into a tube 6 to 7 mm. long, the free tips of filaments about 1 mm. long, staminal tube puberulent, staminodia pilose. Ovary and style pilose, the style thick. Stigma large, capitate, entire.

Type in the Herbarium of the University of Michigan, *H. H. Bartlett* 12558, collected in high forest (*cedral*) at Uaxactun, Department of Petén, Guatemala, April 10, 1931; vernacular name "*xililche*."

ERICACEAE

Pyrola elatior (Lange) comb. nov.

Actinocyclus secundus elatior Lange, Vidensk. Meddel. 1867:115. 1868.

Ramischia elatior (Lange) Rydberg, N. Amer. Fl. 29:29. 1914.

The Mexican plant resembles the widespread *Pyrola secunda* L. Since it has been known only from Mt. Orizaba, the following collection is a considerable extension of range. *Eizi Matuda* 2315, collected on Mt. Tacana, Chiapas, Mexico, Aug. 1938; alt. 2000—4038 m.

MYRSINACEAE

PARATHESIS CUBANA (A.D.C.) Molinet & G. Maza, Dicc. Bot. 11. 1889.

Parathesis obovata Standl., Field Mus. Bot. 4:250. 1929, **syn. nov.**

A comparison of the type of *P. obovata*, Karling 29 in Field Museum Herbarium, and the numerous other collections from the Yucatan Peninsula with type material of *P. cubana*, Wright 2910 in Gray Herbarium, and other specimens from Cuba, leaves no doubt but that the two are conspecific.

RUBIACEAE

***Bouvardia Matudai* sp. nov.**

Suffruticosa (?). Ramuli graciles, hornotini longitudinaliter bisulcati. Stipulae 5—8.5 mm. longae, laciniatae. Folia opposita, 2—6. mm. longe petiolata, ovato-lanceolata vel lanceolata, 5—10.5 cm. longa, 2—4.1 cm. lata, apice acuminata, basi acuta vel rotundata, membranacea, ciliata. Inflorescentiae terminales, cymosae. Pedicelli 2.5—10 mm. longi. Calyx 4-lobatus, lobis lineari-lanceolatis, acuminatis, 3—5 mm. longis. Corolla ut videtur rubra, extus glabra, intus ad basin villosa, tubo 10—12 mm. longo, lobis ovatis 2.5—3.5 mm. longis, acutis. Stamina inclusa. Capsula subglobosa, 3.5—4 mm. diam.

Branches suffrutescent, slender, weak, bisulcate, margins of grooves bearing scattered hairs, glabrous otherwise. Stipules 5 to 8.5 mm. long, lacinate, villous at base. Leaves opposite, the petioles 2 to 6 mm. long, canaliculate, glabrous, the blades ovate-lanceolate or lanceolate, 5 to 10.5 cm. long, 2 to 4.1 cm. wide, apex acuminate, base acute to rounded, membranaceous, concolorous when dry, ciliate, glabrous otherwise, obscurely striolate, pinnately veined, the costa and veins slightly impressed above. Inflorescence terminal, cymose, the cymes pedunculate, few-flowered. Pedicels 2.5 to 10 mm. long, slender, glabrous. Hypanthium about 1 mm. long, glabrous. Calyx lobes erect, linear-lanceolate, acuminate, 3 to 5 mm. long, with small hair-like intermediate teeth, sparsely ciliate, otherwise glabrous. Corolla apparently red, with a villous ring within above the base, entirely glabrous otherwise, the tube 10 to 12 mm. long, the limb 4-lobate, the lobes ovate, 2.5 to 3.5 mm. long, acutish. Stamens inserted in tube, the filaments very short. Anthers included in tube, about 2.3 mm. long. Style included; the stigma bifid. Capsules subglobose, 3.5 to 4 mm. in diam.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2667, collected on Mt. Ovando, Chiapas, Mexico, Feb. 1939.

B. Matudai is related to *B. Conzattii* Greenman of Oaxaca, a species which has, according to description, shorter puberulent petioles, much smaller puberulent leaf blades, hypanthium 1.5 mm. long, and corolla

lobes only 2 mm. long. The leaves of *B. Matudai* are ciliate, but entirely glabrous otherwise.

Gonzalagunia tacanensis sp. nov.

Frutex 3-metralis, 15 cm. diam.; ramulis hirsutis. Folia 4—7 mm. longe petiolata, chartacea, elliptica, 8—13.5 cm. longa, 3—5.4 cm. lata, apice basique acuminata, nervis lateralibus primariis 9—10. Inflorescentia spiciformis, 19—25 cm. longa, rachibus hirsutis, cymulis sessilibus, pedicellis 1—3 mm. longis. Calyx truncatus, glaber. Corollae tubus ca. 16 mm. longus, extus adpresse pilosus, intus villosus; lobi ca. 3 mm. longi, extus glabri. Ovarium quadriloculare. Fructus subglobosus in siccitate 4—5 mm. diam.

A shrub 15 cm. in diam., 3 m. high; branchlets rather stout, densely sordid-hirsute. Stipules triangular, subulate-acuminate, 3.5 to 5 mm. long, rigid, keeled, glabrous outside, hirsute within. Petioles sparsely hirsute, canaliculate, 4 to 7 mm. long. Leaf blades chartaceous, elliptic, 8 to 13.5 cm. long, 3 to 5.4 cm. wide, apex and base acuminate, sparsely short hirsute above at first, glabrescent early, lower surface at first sparsely covered with very fine appressed silky hairs, subarachnoid, the costa and veins short appressed hirsute, costa prominent beneath, main lateral veins 9 or 10 on each side, strongly and arcuately ascending, prominulous beneath. Inflorescence spiciform, usually 19 to 25 cm. long, sometimes shorter, the rachis hirsute, cymules sessile or essentially so, the pedicels 1 to 3 mm. long, appressed hairy. Calyx and hypanthium glabrous, about 2 mm. long, subtruncate, the 4 lobes minute, scarcely discernible. Corolla tube finely appressed pilose, about 16 mm. long, 2.5 mm. thick in throat, the lobes short, about 3 mm. long, minutely papillate, glabrous otherwise outside, throat and tube villous within. Stamens equaling tube. Style included, the stigma 4-lobate. Ovary 4-celled. Fruit tetracoccus, depressed-globose, 4 to 5 mm. in diam. when dry.

Type in the Herbarium of the University of Michigan, *Eizi Matuda 2462*, collected on Mt. Tacana, Chiapas, Mexico, Aug. 1938; alt. 1000—2000 m.

G. tacanensis has affinity with *G. thyrsoides* (Donn. Sm.) B. L. Robinson of nearby Guatemala from which it may be separated, according to description, by the much smaller leaves, subtruncate calyx, and corolla with lobes only 3 mm. long.

CAPRIFOLIACEAE

Viburnum montanum sp. nov.

Frutex 3-metralis, 12 cm. diam. Folia glabra, 6—9 mm. longe petiolata, coriacea, lanceolata, 4.5—8.2 cm. longa, 1.5—3.5 cm. lata, apice attenuato-acuminata, basi rotundata, integra; costa et venulis supra impressis. Inflorescentia glabra, pedunculata; calycis tubus obconico-cylindricus,

glaber, eglandulosus, 2—2.2 mm. longus; calycis lobi glabri, eciliati. Corolla glabra, 3.5—4 mm. longa, lobis rotundatis. Stylus parce hirsutus.

A shrub 12 cm. in diam., 3 m. high; branches terete, striate; branchlets angled, striate, glabrous, straight, rather stout. Leaves opposite, entirely glabrous; the blades coriaceous, lanceolate, 4.5 to 8.2 cm. long, 1.5 to 3.5 cm. wide, apex attenuate-acuminate, base usually rounded, sometimes rounded and slightly acutish, with one or two minute glandular teeth near base, otherwise entire, somewhat paler beneath, costa prominent beneath, impressed above, primary veins 4 or 5 on each side, strongly arcuately ascending, prominulous beneath, impressed above, veinlets openly reticulate on undersurface. Petioles canaliculate, 6 to 9 mm. long. Inflorescence glabrous, pedunculate; peduncle 4.2 cm. long; bracts at base of inflorescence deciduous; cyme twice compound, small; primary rays 6, up to 13 mm. long, the secondary much shorter; terminal flowers sessile, lateral ones pedicellate, the pedicels up to 3 mm. long; bractlets subtending flowers linear. Calyx tube thick, obconic-cylindric, 2 to 2.2 mm. long, glabrous, eglandular; lobes triangular, about 0.6 mm. long, glabrous, not ciliate. Corolla broadly campanulate, 3.5 to 4 mm. long, glabrous, the lobes rounded, about 2 mm. long. Filaments 3 to 4 mm. long, slightly exserted; anthers 1 mm. long. Style sparsely short hirsute.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2564, collected on Mt. Ovando, near Escuintla, Chiapas, Mexico, July 1938; alt. 1250—2370 m.

V. montanum keys at once to Morton's section Caudata (Contrib. U. S. Nat. Herb. 26:342. 1933) which contains a single species, *V. caudatum* Greenman. The latter has much larger leaves, rhombic-ovate rather than lanceolate with bearded vein axils beneath, a glandular inflorescence, ciliate calyx lobes, and other significant differences. In spite of the sparsely hirsute style, the affinity of *V. montanum* appears to be with *V. blandum* Morton of the section Mexicana (l.c.) which occurs on Mt. Ovando also (*Matuda* 431, identified by C. V. Morton). From that species it may be separated by the stouter straight branchlets, coriaceous lanceolate leaves with costa and veins impressed above, and sparsely hirsute style.

***Viburnum tacanense* sp. nov.**

Frutex 4-metralis, 10 cm. diam. Folia 3.5—8 mm. longe petiolata, chartacea, obovata vel elliptica, 2.5—4.6 cm. longa, 1.4—2.5 cm. lata, apice abrupte et breviter acuminata vel apiculata, basi cuneata, sub-integra, ciliata, subtus secus costam et in axillis albido-barbata. Cymae 2—4 cm. longae, subsessiles vel breviter pedunculatae, subadpresse hirsutae. Calycis tubus obconico-cylindricus, 2—2.4 mm. longus, parce rufo-glandulosus; calycis lobi parce ciliati. Corolla glabra, 3—3.5 mm. longa, lobis rotundatis. Stylus glabrus.

A shrub 10 cm. in diam., 4 m. high; branches terete; branchlets slightly ribbed, rather sparingly subappressed hirsute with white hairs, these simple or few-branched at base. Leaves opposite; the blades chartaceous, obovate or elliptic, 2.5 to 4.6 cm. long, 1.4 to 2.5 cm. wide, apex abruptly short acuminate or acutely apiculate, base cuneate, subentire, often with one or two minute glandular teeth near base and apex, paler beneath, appressed ciliate, glabrous above except for appressed coarse hairs on the costa, barbate with white hairs beneath in the vein axils and along the lower third of costa, glabrous otherwise very early, primary veins usually 4 on each side, slightly raised beneath, strongly ascending, with age openly but rather obscurely reticulate-veined. Petioles canaliculate, glabrous except for a few appressed hairs above and at apex below, slender, 3.5 to 8 mm. long. Inflorescence usually subsessile, the primary rays of cymes appearing fasciculate, the peduncles rarely as much as 13 mm. long in fruit, pubescent like the branchlets; cymes as much as 4 cm. long in fruit (including peduncle), usually less than 2.5 cm. long, twice or thrice compound, the rays sparingly appressed hairy and red glandular, the primary rays exceeding the secondary in length; terminal flowers sessile, lateral pedicellate, the pedicels red glandular; bractlets subtending flowers deciduous early, linear-spatulate or linear-oblong, usually 3.5 to 4 mm. long, sometimes reduced, ciliate. Calyx tube obconic-cylindric, 2 to 2.4 mm. long, rather sparsely red-glandular, glabrous otherwise; lobes oblong, about 1 mm. long, very sparingly short ciliate. Corolla companulate, 3 to 3.5 mm. long, glabrous, the lobes rounded. Filaments about 2.3 mm. long; anthers 1 mm. long. Style glabrous, thick, conical; stigma thick, capitate, obscurely 3-lobed. Fruits obovoid, about 1 cm. long (including persistent style and calyx lobes), glabrous, slightly compressed laterally, grooved on two sides; the intrusion of endocarp broad, bilobed, and conspicuous, short stipitate in cross section.

Type in the Herbarium of the University of Michigan, *Eizi Matuda* 2332, collected on Mt. Tacana, Chiapas, Mexico, Aug. 1938; alt. 2000—4038 m.

V. tacanense evidently is referable to the section *Mexicana* of Morton (l.c.). It does not appear close to any of the described species excepting perhaps *V. microphyllum* (Oerst.) Hemsl. which has entire oblong or lanceolate rather than obovate leaves, much larger long peduncled cymes, and a smaller corolla.

The Cruciferous Genus *Stanleya*

REED C. ROLLINS¹

Stanleya has recently come to the attention of biologists because of the ability of plants of this genus to accumulate in their tissues relatively large quantities of selenium. These plants have been frequently mentioned as indicators of selenium-bearing soils and as such are of importance in the locating and mapping of seleniferous areas.² Trelease,³ as a result of a series of experiments in which a number of species of *Astragalus* were grown in solutions containing various quantities of selenite has suggested, "that selenium may be an essential microtrophic element" for *Astragalus*, *Stanleya* and other indicator plants commonly found on selenium-bearing soils. To the phytogeographer, this information is of considerable importance because of its bearing upon plant distribution in areas where selenium is present in discontinuous geological formations. In fact, this is probably a basic factor in the actual sporadic occurrence of some species of *Stanleya* as indicated by the accompanying maps and citations of specimens.

Soil analyses from a few of the areas where outlying collections of *Stanleya pinnata* have been made indicate an interesting relationship between its occurrence and the presence of selenium in the soil. In some of the outstanding instances of disrupted distribution of this species which have come to my attention, namely: Weston County Wyoming, southwestern North Dakota and Trego and Logan Counties in Kansas, at least small quantities and usually relatively large amounts of selenium have been found in the soils of each immediate area.⁴ It has not been conclusively shown that selenium is necessary for the normal growth of *Stanleya*, hence, from the physiological standpoint it cannot be stated with certainty that a correlation exists between the occurrence of these plants and selenium-bearing outcrops. From the data available it is only possible to say that where plants of certain species of *Stanleya* are found, there is a strong likelihood that the soils upon which they are growing contain at least small quantities of selenium in one form or another.

Field observations in many areas of the western United States indicate that *Stanleya* is most often found on "gumbo" or "adobe" soils chiefly in the Upper Sonoran life-zone. None of the species have become adapted to conditions found in the mountains proper, but plants of the genus may be found on the plains and in the intermontane basins from North Dakota and Texas west to southern California. These plants often form a conspicuous part of the vegetation locally where in many areas they are associated

¹ The Society of Fellows of Harvard University.

² See Beath et al., *Am. Journ. Bot.* **24**: 96-101 (1937), and **26**: 296-315 (1939).

³ *Ibid.* **25**: 379 (1938).

⁴ See Moxon et al., *ibid.* **25**: 794 (1938).

in large or small colonies. The flowers are borne in long racemes which in their plume-like appearance stand out as "sentinels of the desert" against a darkened skyline. In view of this fact, it seems particularly fitting that the common name "Desert Plume" which has been rather widely used in manuals and popular treatises on botany should be perpetuated.

The nearest related genus to *Stanleya* is *Thelypodium* which according to Payson⁵ may have been derived from it. The connection between these two genera is most noticeable when the morphological features of *Stanleya confertiflora* are compared with such species as *Thelypodium eucosum* and *T. brachycarpum* or when *S. tomentosa* var. *runcinata* is compared with *T. laciniatum*. In fact the morphology of the flower, fruit and leaves is so close between these entities of different genera, that they might with some propriety be considered congeneric. *Stanleya* is distinguished from *Thelypodium* by a relatively long gynophore (1 cm. or more), connivent sepals in the large clavate bud and by the fact that the sepals are spreading or reflexed at anthesis. Actually there is a definite and convenient hiatus between the two and *Stanleya*, as now understood, is quite homogeneous. The related species of *Thelypodium* would certainly introduce an anomalous element if they were transferred. O. E. Schulz⁶ has placed *Stanleya* and *Thelypodium* in widely separated tribes of the Cruciferae, but on the basis of observed facts such a disposition is decidedly unwarranted. In so far as these genera are concerned, the retention of the tribe Thelypodieae of Prantl⁷ as modified by von Hayek⁸ more nearly presents the actual phylogenetic relationships in this group than does the system of O. E. Schulz.

The long gynophore supporting each silique is a unique feature of *Stanleya*. It is found in only a small number of other genera of the family where its development is far less marked. The structure is homologous with the gynophore of the Capparidaceae and is usually considered an important link in the line of evidence pointing to a close relationship between the Cruciferae and the Capparidaceae. It is currently believed by many botanists that the Cruciferae were derived from the Capparidaceae or some capparidaceous-like complex not now known. This hypothesis is supported by considerable morphological and geographical evidence.⁹ It is not my purpose to give a detailed discussion of these relationships, but it seems worth while to relate a few of the salient points of gross morphological similarity. At the outset it should be emphasized that the fundamental floral plan of the Cleomoideae (Capparidaceae) is the same as that of the

⁵ Ann. Mo. Bot. Gard. **9**: 224 (1922).

⁶ Pflanzenfam. **17b**: 294 and 582 (1936).

⁷ Ibid. **3**: 2, 154 (1891).

⁸ Beih. Bot. Centralb. **17**: 2, 179 (1911).

⁹ For references on this question see von Hayek op. cit. and O. E. Schulz op. cit.

Cruciferae. Some members of the Thelypodieae and the Cleomoideae have such characteristics in common as a long stipe or gynophore, long filaments of nearly equal length which exceed the other flower parts and reflexed sepals at flower-anthesis. *Stanleya* is scarcely tetradynamous. The stamens are so nearly equal that only rarely can a difference in length of single and paired stamens be detected. This is a significant departure from the uniform tetradynamy so characteristic of the crucifer flower. From the practical taxonomic standpoint, the relationship between *Stanleya* and the Capparidaceae is emphasized by the typical comment of Jepson,¹⁰ who says of *S. pinnata*, "remarkably capparidaceous in habit and in certain points of flower structure." In this connection it should be remembered that the first plants of *Stanleya* discovered were described as a new species of *Cleomé*.

Sinnott and Bailey¹¹ have presented convincing evidence for the antiquity of a woody habit in plants as opposed to the more recent herbaceous growth form. From this standpoint the Capparidaceae, where a woody habit is common, must be considered older than the Cruciferae, where the habit of growth is almost exclusively herbaceous and even semi-woody types are uncommon.

Geographical distribution favors the supposition that the Capparidaceae are the older of the two. In general the Capparidaceae occur in tropical and subtropical areas and are found in such an old floristic region as Aus-

Name of Plant	Place of Collection	Collector and Number	Chromosome Number	
			<i>N</i>	<i>2N</i>
<i>Stanleya pinnata</i>	Fremont Co., Colorado	Rollins 2066	12	24
<i>Stanleya pinnata</i>	Pueblo Co., Colorado	Rollins 2810	12	
<i>S. pinnata</i>				
var. <i>bipinnata</i>	Albany Co., Wyoming	Rollins 2396	ca. 12	
<i>S. pinnata</i>				
var. <i>integrifolia</i>	Mesa Co., Colorado	Rollins 2173	12	
<i>S. pinnata</i>				
var. <i>integrifolia</i>	Sweetwater Co., Wyoming	Rollins 2240	ca. 24	
<i>S. pinnata</i>				
var. <i>gibberosa</i>	Uinta Co., Wyoming	Rollins 2228	12	
<i>Stanleya elata</i>	Nye Co., Nevada	Rollins & Chambers 2499	12	
<i>Stanleya viridiflora</i>	Uinta Co., Wyoming	Rollins 2343	12	24
<i>Streptanthus cordatus</i>	Gunnison Co., Colorado	Rollins 2102	12	
<i>Caulanthus crassicaulis</i>	Uinta Co., Wyoming	Rollins 2330	12	
<i>Caulanthus crassicaulis</i>	Sweetwater Co., Wyoming	Rollins 2264	12	
<i>Cleome lutea</i>	Mesa Co., Colorado	Rollins 2157	ca. 16	
<i>Cleome serrulata</i>	Uinta Co., Wyoming	Rollins 2339	16	

¹⁰ Fl. Calif. 2:20 (1936).

¹¹ Ann. Bot. 112:547-600 (1914).

tralia. The Cruciferae occur throughout the world, but their great development is in the newer temperate areas of both hemispheres. When plants of this family are found in tropical areas, they are usually confined to the mountains at relatively high elevations and probably represent comparatively recent migrations.

Although a considerable amount of rather conclusive evidence is on hand in support of the thesis briefly and incompletely developed above, very little of it has been derived from the cytology of these groups. For the present study only limited cytological material of the Thelypodieae and of the genus *Cleome* of the Cleomoideae has been available. Chromosome numbers have been determined in three species and three varieties of *Stanleya*, in *Caulanthus crassicaulis*, *Streptanthus cordatus* and in two species of *Cleome*. From the tabulated data, the basic chromosome number for *Stanleya* is apparently twelve. This number may also be common in the Thelypodieae generally. In the Cleomoideae, numbers of 10, 11, 12 and 16 have been reported.¹² The evidence from the meager cytological data presented above is not positive, but the approximate agreement in chromosome numbers in the two groups suggests a possible relationship. In any case it does not oppose the conclusions arrived at as the result of the study of the morphological and geographical evidence.

It will be noted from the accompanying table that a collection of *S. pinnata* var. *integrifolia* from Sweetwater County Wyoming, possessed a haploid number of about twenty-four chromosomes instead of the usual twelve. Thus polyploidy in the genus *Stanleya* is indicated. Considering its great variability and wide geographic range, polyploidy might have been anticipated in *S. pinnata*. Its occurrence in this species is, therefore, not surprising. A combined genetical and cytological study of *S. pinnata* and its varieties would doubtless elucidate perplexing puzzles in variation which have remained unsolved in the present study.

Within the genus *Stanleya* two inter-related groups are evident, but these are not sufficiently defined nor is the genus large enough to necessitate its division into subgenera. *S. pinnata* and *S. albescens* are related and differ from other species of the genus in having petals with expanded blades, densely pilose inner claw surfaces, an easily discernible constriction between blade and claw and definitely incumbent cotyledons. The other species have a number of characteristics in common, but they are not equally inter-related. This latter group has reduced petal-blades which taper imperceptibly into the thicker glabrous claw. Here, the cotyledons are not uniformly disposed, but show transitionary stages between an incumbent and accumbent position. This is particularly true in *S. elata* and *S. confertiflora*. *S. viridiflora* and *S. tomentosa* appear always to have

¹² See Tischler, Tab. Biol. 16:173 (1938).

accumbent cotyledons. Of these four species, *S. confertiflora* and *S. viridiflora* are obviously the most closely related pair.

It is difficult to reconstruct the probable evolutionary history of the

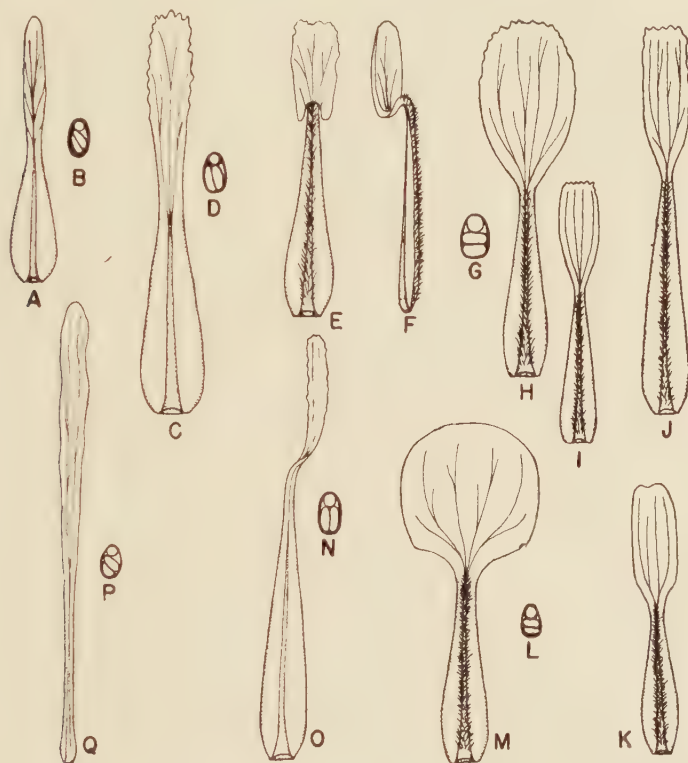


Fig. 1. A-B, *Stanleya elata* drawn from Rollins & Chambers 2499; A—petal, B—transverse section of seed. C-D, *S. viridiflora* drawn from Rollins 2809; C—petal, D—transverse section of seed. E-F, *S. pinnata* var. *gibberosa* drawn from Rollins 2320; E—ventral view of petal, F—side view of petal. G-J, *S. pinnata* var. *typica*; G—transverse section of seed, H—petal drawn from Watson 105 Monitor Valley Nevada, I—petal drawn from Cowen Soldier Canyon-Sulphur Spring Colorado, J—petal drawn from Rollins 2066. K—petal of *S. pinnata* var. *bipinnata* drawn from Goodding 1925. L-M, *S. albescens* drawn from Rollins 2123; L—transverse section of seed, M—ventral view of petal. N-O, *S. tomentosa* drawn from Williams 3285; N—transverse section of seed, O—ventral view of petal. P-Q, *S. confertiflora* drawn from the type; P—transverse section of seed, Q—ventral view of petal. All figures are three times natural size.

species of *Stanleya*, but it does seem probable that two or possibly three lines of development have taken place from the original ancestral stock. For several reasons *S. pinnata* seems to represent the most ancient type in the genus. It has a sub-shrubby habit of growth, which as we have pointed out above appears to be a primitive character. Since this type of

development is rare in the Cruciferae, it is notable that *Stanleya* is usually considered one of the primitive genera in the family. *S. pinnata* has a generalized type of petal with expanded blade and claw from which the other petal-types may easily have been derived by simple reduction. The claw of the petal is exceedingly reduced in *S. confertiflora*, whereas it is well-developed in *S. elata* and *S. tomentosa*, but the petal-blade is much reduced. There is considerable variation in the petals of *S. pinnata*, a fact which points toward these trends of independent reduction in the genus. Roughly covering the combined geographical area of all the other species, *S. pinnata* is by far the most widely distributed. Since it is not an aggressive annual, has no special mechanism of seed dispersal and in no case occupies a geologically old area, its wide-spread distribution strengthens the argument for its relative antiquity and favors the supposition that it more nearly approaches the ancestral type than any other member of the genus. There is no genetic evidence available on this point. Complete genetic and cytological data on *Stanleya* would certainly add weighty evidence to any phylogenetic arrangement of the group.

In considering species differentiation and the relationships between various biological entities in *Stanleya*, several evolutionary trends become apparent. Most noticeable are the following: 1. divided toward entire leaves; 2. petiolate toward sessile amplexicaule leaves; 3. basal leaves absent toward basal leaves present; 4. broad, showy toward narrow, inconspicuous petal-blades; 5. woody-based perennial toward herbaceous annual growth habit. Using these premises as criteria for phylogenetic arrangement, *S. confertiflora* relates to *S. pinnata* through *S. viridiflora* and terminates a single line of development. *S. tomentosa* has some characters in common with *S. viridiflora*, but appears to have arisen independently, possibly through *S. albescens*. *S. elata* seems to be about equally related to *S. pinnata* and *S. albescens*, but is not close to either. However, it doubtless had its origin somewhere near those two species.

The status of *Stanleya* as a genus has not been questioned since its original publication by Nuttall, but it has not always been well understood. This is shown by the fact that a number of species have been referred to it which belong in other genera of the Cruciferae. *Stanleya* has been treated in part by the writers of various manuals and floras on the botany of western North America, but no monographic study of the genus as a whole has been previously made. The most satisfactory treatment is that of Robinson in the Synoptical Flora of North America, but it is now considerably out of date. The generic type of *Stanleya* is *S. pinnata* (Pursh) Britt., based on *Cleome pinnata* Pursh.¹³ *S. pinnatifida* Nuttall appears to have been a direct substitution for Pursh's earlier name although it was founded on

¹³ Fl. Am. Sept. 2:739 (1814).

Nuttall's own specimens. This species is excellently illustrated by Gray¹⁴ and by O. E. Schulz.¹⁵

The present study was carried out chiefly at the Gray Herbarium of Harvard University and I am indebted to the Director, Professor M. L. Fernald, for unlimited freedom in the use of the available facilities. I am also indebted to Professor Karl Sax, in whose laboratory the cytological work used in this paper and others now in press has been done. The following institutions or individuals have either loaned or allowed me the use of their material: I. W. Clokey (Cl); Gray Herbarium (G); New York Botanical Garden (NY); North Dakota Agricultural College (NDA); Philadelphia Academy of Sciences (Ph); University of Idaho, Southern Branch at Pocatello (Poc); Pomona College Herbarium (P); Rocky Mountain Herbarium (RM); University of California (UC); United States National Herbarium (US). Collections marked (R) are in my own herbarium.

SYNOPSIS OF THE GENUS *Stanleya* Nuttall, Gen. N. Am. Pl. 2:71 (1818).

Podolobus Rafin., Am. Monthly Mag. 4:194 (1819) nomen nudum.

Annual or perennial, sub-shrubby or usually herbaceous, plants glabrous or pubescent with simple trichomes; stems simple or branched, 2—15 dm. high; radical leaves present as a basal rosette or absent; cauline petiolate or sessile and auriculate, highly dissected to entire; inflorescence racemose, dense, usually a decimeter or more long; buds clavate; sepals linear-oblong, reflexed or spreading at anthesis; petals yellow to white, often conspicuous; filaments nearly equal, glandular tissue usually surrounding base of single stamen, obsolete or on under side only of paired stamens; siliques borne on a long (1—3 cm.) gynophore, linear, flattened parallel to septum or nearly terete; stigma sessile or the style only slightly developed; seeds oblong, marginless, 25—100 in each loculus; cotyledons accumbent to incumbent, variable in some species.

KEY TO THE SPECIES OF *STANLEYA*

Middle and upper cauline leaves petiolate; leaves pinnatifid or entire; inner surface of petal-claw densely villose or glabrous.

Inner surface of petal-claw densely villose, petal-blade 1.5—10 mm. wide; lower cauline leaves usually pinnatifid, if entire then less than 2 cm. wide.

Petal-blades bright yellow, oblong, 1.5—3 mm. wide; siliques arcuate to nearly straight, ascending or spreading; plants perennial, woody-based. 1. *S. pinnata*

Petal-blades pale yellow or whitish, obovate, 4—10 mm. wide, siliques straight, ascending; plants biennial, not woody-based. 2. *S. albescens*

Inner surface of petal-claw glabrous, petal-blade ca. 1 mm. wide, pale yellow to white; lower cauline leaves entire or rarely runcinate, large, 3—10 cm. wide.

Plants densely pilose or tomentose; basal leaves runcinate; siliques straight, erect, flattened parallel to septum. 3. *S. tomentosa*

Plants glabrous; leaves entire or nearly so; siliques arcuate-spreading, terete. . . . 4. *S. elata*

¹⁴ Gen. Ill. 1:153, plate 65 (1848).

¹⁵ Pflanzenfam. 17b:294, fig. 152 (1936).

Middle and upper cauline leaves sessile, auriculate-clasping; leaves entire or at most with a few teeth; petals glabrous.

Basal leaves numerous, petiolate; petals 2—3 mm. broad at base; pedicels stout, 4—7 mm. long; siliques arcuate. 5. *S. viridiflora*

Basal leaves few, sessile; petals less than 1 mm. broad at base; pedicels slender, 1—2 cm. long; siliques nearly straight, ascending. 6. *S. confertiflora*

1. STANLEYA PINNATA (Pursh) Britton, Trans. N. Y. Acad. 8:62 (1889)

Sub-shrubby perennial; stems several to many from a branching woody base, simple or usually branched above, glabrous or sparsely pilose, glaucous, 4—15 dm. high; truly radical leaves absent; lower cauline leaves usually pinnatifid, but sometimes bipinnate, deeply lobed or rarely nearly entire, petiolate, broadly lanceolate in outline, glabrous or pilose with short flat hairs, 5—15 cm. long, 2—5 cm. wide; upper cauline linear-lanceolate to ovate, petiolate, entire or pinnatifid, glabrous or sparsely pilose, 3—10 cm. long, 3—20 mm. wide; inflorescence congested-racemose, conspicuous, 1—3 dm. long; flowers very numerous; pedicels stout, divergent, glabrous or sparsely pilose, 6—12 mm. long; buds yellowish; sepals spreading or reflexed at anthesis, glabrous, linear, dilated at base, 1—1.5 cm. long, ca. 2 mm. wide, apex with an inconspicuous callus; petals 10—16 mm. long, sharply differentiated into blade and claw; blade yellow oblong to nearly oval, glabrous, 1.5—3 mm. wide, 3—6 mm. long; claw brownish, densely villose on inner face, gradually narrowing from expanded base to blade; stamens exceeding the petals, equal or nearly so; filaments pilose at base, nectar glands surrounding filament of single stamens, subtending filaments of paired stamens; siliques borne on a long very conspicuous gynophore, linear, nearly terete, conspicuously veined, one-nerved to middle or slightly above, widely spreading, arcuate to nearly straight, glabrous or rarely sparsely pilose, 3—8 cm. long; stigma sessile or nearly so, unexpanded; gynophore slender, pilose at base, 1—2.5 cm. long; cells of septum homogeneous; seeds oblong, plump, ca. 2 mm. long, 1 mm. broad, wingless, brown.

KEY TO THE VARIETIES OF *S. PINNATA*

Petals straight or nearly so; plants glabrous or pubescent; leaves bipinnate to entire.

Siliques tortuous and torulose; plants pubescent; leaves mostly bipinnate. southern Wyoming and northern Colorado. var. *bipinnata*

Siliques not tortuous and torulose; plants glabrous or pubescent; leaves pinnate or entire, the lower rarely bipinnate.

Upper cauline leaves broadly ovate, entire, lower cauline leaves entire or somewhat divided. var. *integrifolia*

Upper cauline leaves oblanceolate to angustate, entire or divided, lower leaves pinnate or rarely bipinnate. var. *typica*

Petals strongly crooked between blade and claw; plants rather densely pubescent; all the leaves bipinnate. var. *gibberosa*

S. pinnata (Pursh) Britt., var. *typica*

Cleome pinnata Pursh, Fl. Am. Sept. 2:739 (1814).

Stanleya pinnatifida Nuttall, Gen. N. Am. Pl. 2:71 (1818).

S. heterophylla Nuttall ex Torrey & Gray, Fl. N. Am. 97 (1838).

S. fruticosa Nuttall in Journ. Phila. Acad. Sci. 1:180 (1847).

S. arcuata Rydberg in Bull. Torr. Bot. Club 29:232 (1902).

S. canescens Rydberg, *ibid*.

S. glauca Rydberg, *op. cit.* 31:409 (1904).

NORTH AMERICA: precise locality unknown: "on the prairies between the Aricaras and Mandans" 1810?, Bradbury (Ph, type); Louisiana, Nuttall (Ph); Nicollet's North-western exp. May 1839, C. A. Geyer 227 (NY); upper Missouri, Dr. Buckley (G).

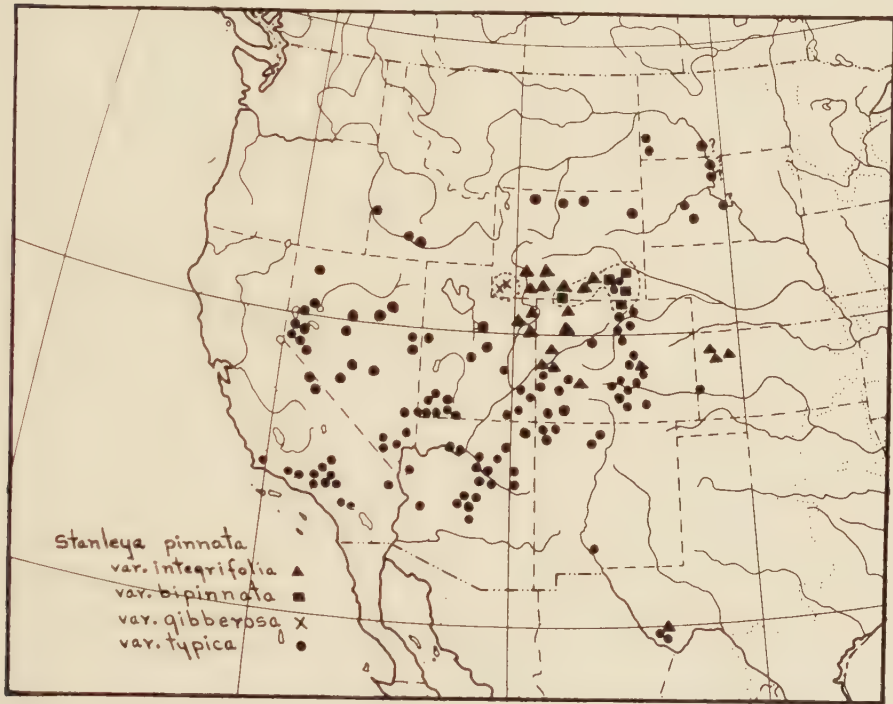


Fig. 2. Ranges of the varieties of *Stanleya pinnata*.

NORTH DAKOTA: Badlands, M. A. Barber 35 (G); Medora, Bolley 67 (NDA,NY); H. F. Bergman 126 (NDA).

SOUTH DAKOTA: White River, Stearns, Stanley Co., T. A. Williams (G); Bluffs, Cheyenne R., Aug. 9, 1891, T. A. Williams (NY); Fall River Falls, June 1892, Rydberg 521 (G).

KANSAS: Coolidge, Hamilton Co., M. A. Carleton (NY).

TEXAS: west Texas, Aug. 1883, V. Havard (US); 9 miles n. Terlingua, Brewster Co., Cory 6585 (G,P).

WYOMING: Newcastle, Weston Co., Bates 556 (G); Dayton, Sheridan Co., Tweedy 2420 (NY); Shell Creek Canyon, Big Horn Co., Stevens & Brenkle 276 (NDA); near Corbett, Park Co., Tweedy 92 (US); Laramie Plains, A. Nelson 1845 (NY); southwest of Laramie, Osterhout (Cl).

COLORADO: Prairie, entrance Soldier Canyon-Sulphur Spring, July, 1895, Cowen (NY type, G isotype of *S. glauca* Rydb.); hills, Larimer Co., C. F. Baker 659 (G); Boulder Co., Bethel, Schmoll & Clokey 4140 (Cl,NY); Kremmling-Walcott, Eagle Co., Rollins 1889 (G,R); Pueblo, Baker, Earle & Tracy 10 (G,NY); 18 mi. north Walsenburg, Huerfano Co., Rollins & Chambers 2407 (G,R); 5 mi. east Florence, Fremont Co., Rollins 2066 (G,R); 2 mi. south Thatcher, Las Animas

Co., *Rollins* 1822 (G,R); Grand Junction, June 1892, *Eastwood* (NY); 1 mile south Gateway, Mesa Co., *Rollins* 1909 (G,R); north of Montrose, Montrose Co., *Payson* 680 (G); 10 mi. northeast Ridgeway, Ouray Co., *Rollins* 1988 (G,R); Mancos, July 1918, *E. Bethel* (US).

NEW MEXICO: Ensenada, Rio Arriba Co., *Standley & Bollman* 11093 (US); northwest of Con-jilon, Rio Arriba Co., *Wolf* 2939 (G); Farmington, San Juan Co., *Wootton* 2788 (US); *Standley* 7110 (US); vicinity Cedar Hill, San Juan Co., *Standley* 8006 (US); Navajo Indian Reservation, *Standley* 7264 (US).

IDAHO: clay hills near Bliss, Gooding Co., *Rollins & Chambers* 2583 (G,R); 14 mi. n. w. Glenns Ferry, Elmore Co., *Rollins* 1156 (G,R); Mann's Creek, Washington Co., *H. M. Tucker* 1160 (Herb. College of Idaho, Caldwell).

UTAH: Provo, *Tracy & Evans* 672 (NY); Green River, May 1890, *M. E. Jones* (NY); Price, *M. E. Jones* 6160 (US); Manti Canyon, San Pete Co., *Tidestrom* 1359 (US); 5 mi. northeast Paragonah, Iron Co., *Rollins & Chambers* 2458 (G,R); south of Mexican Hat, *Goodman & Hitchcock* 1343 (G); near St. George, *McKelvey* 4178 (G); western slope La Sal Mts., *Rydberg & Garrett* 8572 (NY); Zion Nat. Park, C. L. *Hitchcock* 2978 (G); 3 mi. west Gold Hill, *Maguire & Becraft* 2635 (G); Frisco, June 1880, *M. E. Jones* 1809 (NY type of *S. canescens* Rydb.); 35 mi. west Milford, Beaver Co., *Rollins & Chambers* 2462 (G,R); Juab, *Goodding* 1047 (G).

ARIZONA: 18 mi. southeast Tuba City, *Peebles & Smith* 13368 (US); Navajo-Ind. Res., *Standley* 7324 (US); Grand Canyon, *Leiberg* 5935 (US); near Leupp, *Peebles* 9575 (US); Flagstaff-Holbrook, A. & R. A. *Nelson* 2133 (NY); 25 mi. southeast Holbrook, *Rollins & Chambers* 2425 (G,R); 10 mi. west Winslow, *Rollins & Chambers* 2427 (G,R); Holbrook, *M. Zuck* (G,NY); Verdi River, *Rusby* (N.Y.); north of Roosevelt, *Harrison* 7798 (US); Packard-Payson, A. *Eastwood* 17171 (G); Oatman, *Thackery* 4228 (US).

NEVADA: Unionville Valley, June 1868, *S. Watson* 105 (NY type of *S. arcuata* Rydb.) Monitor Valley, *S. Watson* 105 (G); Ely, A. E. *Hitchcock* 1202 (US); 32 mi. s. w. Ely, White Pine Co., *Rollins & Chambers* 2493 (G,R); west of Caliente, *Tidestrom* 9543 (US); Las Vegas, *Tidestrom* 8943 (G,NY,US); Kyle Canyon, Clark Co., *Clokey* 7524 (Cl); so. Austin, Lander Co., *Train* 230 (US); Humboldt Canyon, Humboldt Co., *Heller* 10615 (G,US); Fernly, Churchill Co., *Train* 162 (US); Wassuk Mts., *Tidestrom* 10093 (NY,US); Pyramid Lake, Washoe Co., *Kennedy* 2023 (G); Hermits Canyon, Storey Co., *Kennedy* 1956 (G,US); Wadsworth, *Tidestrom* 10686 (G,US); Mineral Co., *Heller* 10916 (G); 60 mi. n. e. Tonapah, Nye Co., *Rollins & Chambers* 2498 (G,R); near Round Mt., Nye Co., *Rollins & Chambers* 2518 (G,R).

CALIFORNIA: near Benton, Mono Co., *Tidestrom* 10030 (US); near Laws, Inyo Co., *Heller* 8182 (G,US); 2 mi. s. Majove, Kern Co., *Abrams* 11804 (Cl); Santa Clara Valley, Ventura Co., May 1866, *S. F. Peckham* (US); Santa Barbara Co., 1865, *J. Torrey* (NY); San Gabriel Mts., San Bernardino Co., *Ewan* 8467 (G); 5 mi. w. Lucerne, Santa Barbara Co., *Munz & Youngberg* 15169 (G); vicinity of Barstow, *J. N. Rose* 12056 (US); Rock Creek, Los Angeles Co., *Munz & Johnston* 11168 (G); Cottonwood Pass, Riverside Co., *Hall* 5997 (US); Santa Rosa Mts., Riverside Co., *Munz* 15106 (G).

S. pinnata (Pursh) Britt., var. *integrifolia* (James) comb. nov.

S. integrifolia James in Long's Exp. 2:117 (1823).

S. pinnatifida Nutt., var. *integrifolia* Robinson in Gray, Syn. Fl. 1:179 (1895).

S. glauca latifolia Cockerell in Torrey 20:102 (1920).

KANSAS: Trego Co., A. S. *Hitchcock* 22 (G,NY); Edith, Logan Co., May 1920, *Rowena Kesler* (US type, NY isotype, *S. glauca latifolia* Cockerell); Badlands 30 mi. south Oakley, *Rydberg & Imler* 1028 (NY).

TEXAS: Agua Fria Road, Brewster Co., *Cory* 1639 (G); 6 mi. n.e. Agua Fria Spgs., *Cory* 18569 (G); Terlingua Creek, *Havard* 70 (G).

WYOMING: Cummins, A. *Nelson* 1554 (G,NY); Ft. Steele, E. B. & L. B. *Payson* 2538 (G); 4 mi. east Parco, Carbon Co., *Rollins* 2392 (G,R); north of Pilot Butte, Sweetwater Co., *Merrill & Wilcox* 797 (G,NY,US); 3 mi. east Rock Springs, *Rollins* 2391 (G,R); Green River, Sweetwater Co., *Rollins* 2240 (G); *Rollins* 2390 (G,R); A. *Nelson* 7232 (G,NY,US).

COLORADO: central Colorado, Long's Exped. (NY type); 10 mi. s. w. Craig, Moffat Co., *Rollins* 2224 (G,R); 1 mi. s. Axial, Moffat Co., *Maguire & Piranian* 12517 (G); Cimarron, *Baker* 130

(G,NY); Little Book Cliffs, Mesa Co., *Rollins* 1893 (G,NY,R); Colorado Nat. Monument, *Rollins* 1931 (G,NY,R); *Rollins* 2173 (G,R); Naturita, Montrose Co., *Payson* 479 (G).

UTAH: 22 mi. s. Ouray, Uintah Co., *Rollins* 1718 (G,R); south of Vernal, Uintah Co., *Graham* 6291 (G,US); Wells Draw-Minnie Maude Creek, Duchesne Co., *Graham* 9498 (G, US); 10 mi. west Duchesne, Duchesne Co., *Graham* 9272 (US).

***S. pinnata* (Pursh) Birtt., var. *bipinnata* (Greene) comb. nov.**

S. bipinnata Greene in *Erythea* 4:173 (1896).

WYOMING: 5 mi. west Laramie, Albany Co., *Rollins* 2396 (G,R); near Laramie, *J. R. Churchill* (G); South Sybille, Albany Co., *Nelson* 7375 (G,NDA,NY,US); North Vermillion Creek, Sweet-water Co., *Nelson* 3562 (G,NY).

COLORADO: North Fork, Larimer Co., *Goodding* 1925 (G,NDA,NY,Ph,UC,US).

***S. pinnata* (Pursh) Britt., var. *gibberosa* var. nov.**

Plants pubescent throughout with simple, flat trichomes; stems numerous. 1–4 dm. high, slender; leaves bipinnate; petals with a sigmoid curve at the juncture of blade and claw.

Planta pilosa; caulibus tenuissimis 1–4 dm. altis; foliis bipinnatis; petalis sigmoideo-curvatis.

WYOMING: Limy foothills of Bridger Butte, 3 miles west of Fort Bridger, Uinta Co., June 24, 1938, *Rollins* 2383 (G type, R isotype); June, 1938, *Rollins* 2320 (G,R); May, 1938, *Rollins* 2228 (G); June, 1937, *Rollins* 1778 (G,R); 2 miles south Carter, Uinta Co., *Rollins* 2351 (G,R).

The treatment of *S. pinnata* as a huge polymorphous species even with three varietal entities is rather unsatisfactory because such a wide range of variations must be included. Repeated efforts have been made to find points at which natural lines based on sound morphological and geographical evidence might be drawn so that attention could be focused on certain local phases of the species. However, there appear to be complete transitional stages between entire and pinnatifid, broad and linear leaves; glabrous and pubescent stems, leaves and fruits; plants with linear-oblong petal-blades and those with broadly obovate ones; curved versus straight siliques and many other characters which were measured and observed. After ample evidence had been accumulated to show that qualitative characters could not be relied upon to indicate natural specific boundaries, it was thought quantitative data might provide a suitable basis for division at least into subunits. Leaves, stems, fruits and parts of the flower were systematically measured and tabulated on many plants in the field and on all specimens which had been assembled for study. From this, it became evident that plants as well as their parts tended to be slightly larger in the western portion of the range of the species. That is, plants from California, Nevada, Arizona, Utah and western Colorado averaged larger in size of parts and organs than those northward and east of the Rocky Mountains. These quantitative differences were not great and there was always the very perturbing minority of plants from the western area which were far

smaller in all respects than the average for the plants from east of the Rocky Mountains. Besides this, there was little or no coincidence with known phytogeographic boundaries. The conclusion seems inescapable, in spite of the great variation, that *S. pinnata* must be treated in the traditional way as a large, inclusive, wide-ranging species.

Three phases of *S. pinnata* appear to be too well marked morphologically and localized geographically to be left undesignated. The first of these to be briefly considered was early named *S. integrifolia* by James and was later reduced to varietal rank by Robinson, which appears to be its proper status. Extreme forms of var. *integrifolia* from the Green River Basin have all leaves very broad and entire. If these characteristics could be demonstrated as being stable even for a single colony, one might be justified in maintaining *S. integrifolia* intact as a species. Unfortunately this is not the case. All intermediate leaf-types from entire to pinnate may be found in one place or another in the range of var. *integrifolia*. The type of var. *integrifolia*, as near as can be determined from published notes, was collected somewhere northwest of Colorado Springs, Colorado, on "summits of sandstone ridges along the base of the mountains." It is unlikely that the plants were actually growing on sandstone, but more probably in a heavier type of soil. The habitats of *Stanleya* have been carefully observed over a wide area and always the plants were growing in very heavy, often clay-like soil. The type of var. *integrifolia* is very fragmentary and one can only deduce from it that the upper stem-leaves were broad and entire and that the plant is glabrous. The lower parts of the plant are not represented, but observations on plants from the same area of its collection, indicate that the lower leaves were probably not entire. From this evidence it is thought that this variety should include plants with all the leaves broad and entire together with those which have broad entire upper leaves and somewhat divided lower ones. The division is admittedly rather arbitrary and is of the nature of a convenient category to place extreme leaf-forms of the species. This interpretation of the variety is strengthened to some extent by the fact that these broad entire leaf-types occur in an area extending from the Uintah Basin of Utah eastward to the Great Plains; an area by no means comparable in size to that covered by the species as a whole.

Two varieties which doubtless have a measure of genetic stability, as opposed to var. *integrifolia* where it is doubtful whether its distinctive features are genetically stable, are var. *bipinnata* and var. *gibberosa*. Both have the same general characteristics as var. *typica*, but differ definitely in minor ways. Variety *bipinnata* has torulose and tortuous siliques, bipinnate leaves and is in general a smaller plant than var. *typica*. A strongly crooked petal, bipinnate leaves, lower stature and a greater abundance of vestiture distinguishes var. *gibberosa* from the typical variety. Variety

gibberosa has a local unified range in southwestern Wyoming and var. *bipinnata* is found in southern Wyoming and northern Colorado.

This interpretation of *S. pinnata* necessitates the reduction into synonymy of three of Rydberg's species which appear to have been described on rather trivial grounds. *S. glauca*, for example, is described as being a distinctive species, but the supporting evidence is purely of a trivial quantitative sort. It seems to me that a plant must differ from another in something more than dubious quantitative measurements drawn from a single or at most a few specimens, in order to be considered a distinct natural entity of any sort. As pointed out above, the study of a large series of plants of *S. pinnata* has demonstrated that quantitative data lack precise definition and cannot be used to delimit satisfactorily even varietal units. *S. glauca* is described as being "perfectly glabrous," but this is neither true of the type specimen nor the isotype collections. In these, there are scattered trichomes on the under surfaces of the leaves and at the base of each gynophore. The lack of vestiture is stressed by Rydberg, but this feature is variable as in many other members of the Cruciferae and should not be given great weight as a diagnostic character. *S. arcuata* is the same as the much older *S. heterophylla* of Nuttall which represents the western phase of *S. pinnata*. This phase, as pointed out above, has a measure of habital distinctness, but lacks anything of constant diagnostic value by which it might be accurately and consistently separated. An isotype of *S. heterophylla* from the Snake River (Lewis R.) is in the herbarium of the Philadelphia Academy of Sciences and is indeed very similar in every way to my own specimens collected near Bliss, Idaho. These are from the bluffs bordering the Snake River. *S. canescens* Rydberg readily falls within the apparently natural range of variation of *S. pinnata*, hence it cannot be maintained as a separate entity. One of its supposed distinctive characteristics, that of abundance of vestiture, is certainly unstable and transient in nature. I have not seen the type or authentic specimens of *S. fruticosa* Nuttall, but it is evident from the original description that the western phase of *S. pinnata* is described. The phrase "leaves two to two and a half inches long, less than half an inch wide" could hardly be applied to any other species of the genus which cannot be ruled out on other grounds.

2. STANLEYA ALBESCENS M. E. Jones, Zoe 2:17 (1893)

Herbaceous biennial, branching at base; stems one to several, simple or branched, 3—10 dm. high; leaves petiolate, lyrate-pinnatifid, runcinate or rarely entire, lower-most often bipinnate, oblong-ovate to broadly lanceolate, glabrous, glaucous, slate-colored, 8—20 cm. long, 2—8 cm. wide; inflorescence 1—4 dm. long; buds whitish; sepals glabrous, linear-oblong, white, green-tipped, reflexed or spreading at anthesis, 1—1.5 cm.

long, 2—3 mm. wide; petals white to very slightly lemon-yellowish, strongly differentiated into blade and claw, 1—1.5 cm. long, blade 4—10 mm. broad; inner claw villous; stamens exceeding petals, filaments nearly equal, pilose at base; nectar glands surrounding single stamens, subtending paired stamens; pedicels rigid, obliquely spreading, glabrous, 5—12 mm. long; siliques stipitate, erect, nearly terete, slightly curved inward or nearly straight, glabrous, 3—6 cm. long, style ca. 1 mm. long; gynophore slender, 1—1.5 cm. long, pilose at base, glabrous above; seeds wingless, 2 mm. long, 1 mm. wide, cotyledons obliquely incumbent.

COLORADO: 12 mi. so. Grand Junction, Mesa Co., *Rollins 2156* (G,R); Grand Junction, May 1891, *A. Eastwood* (UC); 2 mi. so. Delta, Delta Co., *Rollins 2139* (G,R); above Delta, Delta Co., *Cowen 67* (G); 6 mi. east Montrose, Montrose Co., *Rollins 2123* (G,R); Montrose, *Payson 92* (G); *Payson 652* (G).

NEW MEXICO: locality undetermined, 1869, *Dr. E. Palmer 99* (G,US).

ARIZONA: Moencoppa, June 10, 1890, *M. E. Jones* (P type, G,UC,US isotypes); Moquii Village, Aug. 1891, *J. G. Owens* (G); north of Cameron, Coconino Co., *McKelvey 4469* (G).

Plants of *S. albescens* vary greatly in size and one is unable to ascertain, from herbarium specimens alone, the actual gross dimensions. This is probably due to the fact that most collectors find it convenient to select the smallest plants of a given colony for purposes of making exsiccatae. In western Colorado, this species grows abundantly on clay flats and clay-adobe knolls in the Colorado River Basin. *S. albescens* is very distinctive with its large creamy petal-blades, ascending siliques and thick slate-colored leaves. The lack of a woody caudex marks it as easily distinguishable from *S. pinnata*, its nearest relative in the genus.

3. *STANLEYA TOMENTOSA* Parry, *Am. Naturalist* 8:212 (1874)

Perennial; caudex simple, covered by old leaf-bases; stems erect, stout, pithy, single, tomentose or nearly glabrous above, simple or branched above, leafy, 5—15 dm. high; basal leaves numerous, petiolate, runcinate, broadly lanceolate, acute, thick and felt-like from a dense simple pubescence, 1—3 dm. long, 2—6 cm. wide; lower cauline similar to basal, reduced upwards; upper cauline entire or hastate, short-petiolate, 2—4 cm. long, 5—10 mm. wide, lanceolate; inflorescence greatly elongated, densely congested, 2—6 dm. long; sepals linear, obtuse, pubescent, greenish or pale yellowish, callose at apex, 1—1.5 cm. long, ca. 2 mm. wide; petals pale lemon-yellow, linear, 12—20 mm. long, ca. 2 mm. wide at base, ca. 1 mm. wide at apex, glabrous claw and blade evident; filaments glabrous, stamens exceeding petals; nectar glands well-developed surrounding single stamen, subtending paired stamens; pedicels stout, divaricate, glabrous or hairy at base and apex, ca. 1.5 cm. long; siliques linear, flattened parallel to septum, nerved entire length, straight, glabrous, erect, stipitate, 4—7 cm. long excluding gynophore, ca. 2 mm. wide, stigma sessile; gynophore

1—2 cm. long, glabrous; seeds brown, oblong, wingless, ca. 2.5 mm. long, ca. 1.5 mm. wide; cotyledons accumbent.

S. tomentosa* Parry, var. *typica

WYOMING: Owl Creek, 1873, *C. C. Parry* 13 (G type); Shell Creek Canyon, Big Horn Co., *L. O. & R. Williams* 3285 (G,NY); *Stevens & Brenkle* 275 (NDA); Birds Eye, Fremont Co., *A. Nelson* 9423 (G,US).

***S. tomentosa* Parry, var. *runcinata* (Rydb.) comb. nov.**

S. runcinata Rydberg in Bull. Torr. Bot. Club 30:252 (1903).

Sepals nearly glabrous; petals slender below, blade ca. 2 mm. wide; pedicels glabrous, ca. 1 cm. long; rachis of inflorescence glabrous.

IDAHO?: 1896, *Henderson* ? (US type).

Variety *typica* of this unique species is found in, and adjacent to, the Big Horn Basin of northern Wyoming. It has been collected only a few times, but the plants are abundant in the areas where they are present, according to collectors. The paucity of material in herbaria is probably due to the fact that the region inhabited by the species has not been intensively explored botanically.

Rydberg named *S. runcinata* from a specimen in the U. S. National Herbarium which has questionable data both as to the collector and the place where the collection was made. This specimen is neither typical of *S. tomentosa* nor is it specifically distinct. It shares the characteristic flat erect siliques, runcinate petiolate hairy leaves and densely racemose lemon-yellow flowers of *S. tomentosa* var. *typica*, but differs in having a glabrous inflorescence-rachis, shorter more slender pedicels, nearly glabrous sepals, and petals with a slender claw tapering to a broader blade. The evidence indicates that *S. runcinata* should be maintained as a distinct entity, but in a subordinate rank in *S. tomentosa* with which it agrees in its essential features. It is extremely unfortunate that a specimen with vague and questionable data should have been made the basis for this unit.

4. *STANLEYA ELATA* M. E. Jones, *Zoe* 2:16 (1891)

Coarse short-lived perennial, erect; stems one to several from the base, simple or branched above, glabrous, glaucous, longitudinally striate, 6—15 dm. high; strictly basal leaves absent; leaves petiolate, thick, coriaceous, glabrous or sparsely and minutely pilose below, entire or rarely divided toward base, ovate to broadly oblong, obtuse, upper nearly lanceolate; blade usually cuneate at base, 8—15 cm. long, 3—10 cm. wide; petiole ca. 5 cm. long; inflorescence densely racemose, 1—2 dm. long, elongating in fruit; sepals linear-oblong, yellowish, glabrous, reflexed at anthesis, tipped with a greenish callus, 8—12 mm. long, 1.5—2.5 mm. wide; petals lemon-yellow or nearly white, glabrous, 8—10 mm. long; blade greatly reduced, ca. 1 mm. wide; claw broad at base, strongly nerved; filaments nearly

equal, slightly exceeding sepals, papillose and enlarged at base; pedicels glabrous, 5—10 cm. long; siliques stipitate, nearly terete, glabrous, spreading obliquely or arcuate, 5—10 cm. long; gynophore glabrous, ca. 2 cm. long; style 1 mm. long; seeds numerous, brown, wingless, oblong, 2 mm. long, 1 mm. broad; cotyledons obliquely incumbent.

NEVADA: Rhodes, Mineral Co., June 23, 1882, *M. E. Jones* 3774 (P type, G, UC, US isotypes); Candelaria, *Shockley* 302 (G); 2 mi. west 5 Mile Spring, Nye Co., *Rollins & Chambers* 2499 (G, R); 8½ mi. west Round Mountain, Nye Co., *Rollins & Chambers* 2501 (G, R); near Columbus Marsh, June, 1927, *M. E. Jones* (G, P); east of Lida, June, 1924, *M. E. Jones* (P); Tonapah, Aug., 1923, *M. E. Jones* (P); Kyle Canyon, Charleston Mts., Clark Co., *Clokey* 7523 (G, Cl); *Clokey* 7105 (Cl).

ARIZONA: 20 miles north Tuba City, July 12, 1927, *E. C. Jaeger* (P).

CALIFORNIA: Panamint Mts., Inyo Co., *R. S. Ferris* 7999 (P, UC); May, 1927, *E. C. Jaeger* (P); Black Canyon, White Mts., *Duran* 2693 (P, UC); Argus Mts., May 11, 1897, *M. E. Jones* (P, UC).

S. elata is locally abundant on the open desert and in hot canyons of the Upper Sonoran life-zone in western Nevada, but its total range extends into eastern California and northern Arizona. The species is remarkably distinct morphologically and its immediate relationship to other members of the genus is not entirely clear. Plants of *S. elata* do not develop a basal rosette of leaves as do plants of *S. tomentosa*, and *S. viridiflora*, but in this respect they are similar to plants of *S. pinnata* and *S. albescens*. On the other hand, the petal-type is not that of the latter two species, but rather resembles the type of petal found in *S. viridiflora* and *S. tomentosa*.

5. *Stanleya viridiflora* Nuttall in T. & G., Fl. N. Am. 98 (1838)

S. collina M. E. Jones in Zoe 3:283 (1893).

Coarse perennial; caudex simple, covered with old leaf-bases; stems single, glabrous, simple or branched above, erect, angulate, winged, 3—12 dm. high; basal leaves numerous, petiolate, entire, dentate or rarely more divided, obovate to oblanceolate, obtuse or rarely acute, 1—3 dm. long, 2—6 cm. broad, glabrous; lower cauline similar to basal; cauline leaves progressively reduced upward, middle and upper sessile, sagittate, lanceolate, entire and acute; inflorescence greatly elongated, 1—5 dm. long, elongating more in fruit; buds linear-oblong, clavate, 1—2 cm. long; sepals linear-oblong, glabrous, greenish, 12—16 mm. long, 2—3 mm. wide, spreading or reflexed at anthesis; petals linear-oblong, erose at apex, lemon-yellow or nearly white, glabrous, slightly dilated toward base, no marked hiatus between blade and claw, 1.5—2 cm. long, 2—3 mm. wide; stamens exceeding petals, filaments nearly equal, glabrous, slightly expanded at base; nectar glands surrounding single filament, well-developed below paired filaments but not surrounding them; pedicels stout, obliquely divergent, glabrous, 4—7 mm. long; siliques glabrous, stipitate, arcuate, nearly terete, 4—7 cm. long; gynophore slender, glabrous, 1.5—2.5 cm.

long; seeds oblong, wingless, brown, 2—3 mm. long, ca. 1.5 mm. broad, numerous; cotyledons nearly accumbent.

LOCALITY UNCERTAIN: R. Mts.—N. Calif., *Nuttall* (G).

MONTANA: Shinberger's Canyon, July 1880, *S. Watson* 37 (G).

WYOMING: northwestern Wyoming, *C. C. Parry* 14 (G); Rock Creek, *A. Nelson* 4258 (RM); Wheatland, *B. C. Buffum* 76 (RM); Carbon, Carbon Co., *Osterhout* 6167 (RM); 5 mi. s. Cora, Sublette Co., *E. B. & L. B. Payson* 4678 (RM); Eden-Big Piney, *E. B. & L. B. Payson* 2571

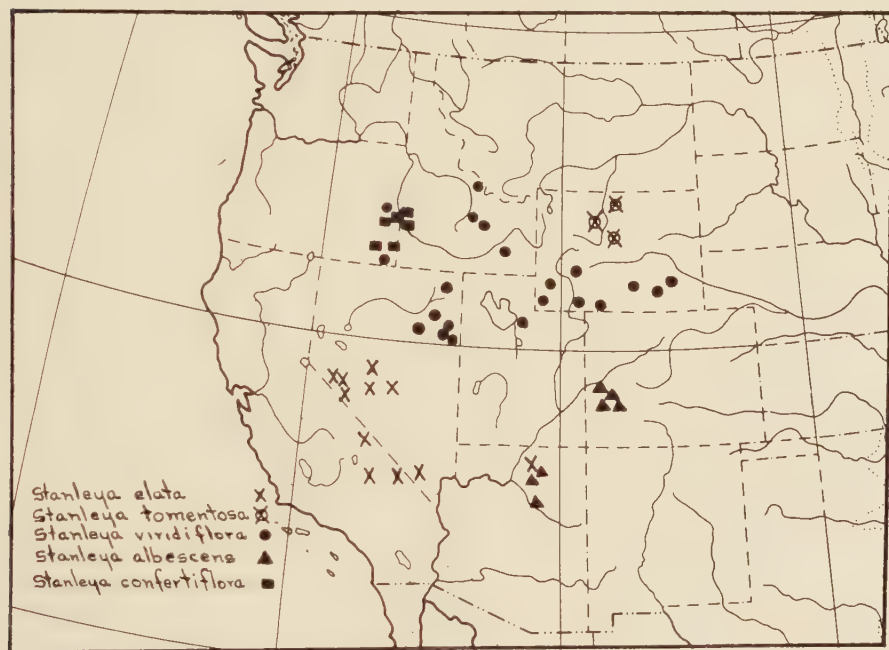


Fig. 3. Ranges of *Stanleya elata*, *S. tomentosa*, *S. viridiflora*, *S. albescens* and *S. confertiflora*.

(RM); North Vermillion Creek, Sweetwater Co., *A. Nelson* 3565 (RM); 3 mi. east Green River, Sweetwater Co., *Rollins* 2809 (G,R); 20 mi. east of Evanston, Uinta Co., *Rollins* 2343 (G).

IDAHO: Mackey, Custer Co., *Nelson & Macbride* 1563 (G,UC); *Nelson & Macbride* 1415 (RM); Arco, Blaine Co., *Macbride & Payson* 3105 (G,RM); Salmon, Lemhi Co., *E. B. & L. B. Payson* 1785 (RM); *R. J. Davis* 484 (Poc); Pocatello, May, 1934, *R. J. Davis* (RM); City Creek, Bannock Co., May, 1934, *R. J. Davis* (RM).

UTAH: Miller Creek, June 8, 1910, *M. E. Jones* (P).

NEVADA: Regan's Valley, *S. Watson* 106 (G); above Cove Creek, Elko Co., *Heller* 9501 (NY, US); 20 mi. s. Jiggs, *Rollins & Chambers* 2511 (G,R); Sprucemont, Elko Co., July 21, 1891, *M. E. Jones* (P type, G,RM,UC,US isotypes of *S. collina* Jones); 4 mi. southwest Ely, White Pine Co., *Rollins & Chambers* 2490 (G).

OREGON: without locality, *Geyer* 97 (G); Oregon Valley, near Nevada line, *Cusick* 2022 (G,RM, UC); Burnt River, eastern Oregon, *Cusick* 1931 (G,UC).

The type of *S. viridiflora* has not been studied, but there can hardly be any question about the application of Nuttall's description. There is a

specimen of this species in the Gray Herbarium marked "S. integrifolia affin., R. Mts.-N. Calif." in Nuttall's handwriting. In so far as I am aware, Nuttall did not publish a species of *Stanleya* with the epithet "integrifolia." Perhaps this specimen was one of those from which his original description of *S. viridiflora* was drawn, but unfortunately I have not had the opportunity of examining the material of *Stanleya* at the British Museum or this point might have been settled. The type of *S. collina* Jones is typical of *S. viridiflora* in every way. The name *S. collina* was only provisionally proposed, hence there is a technical question regarding its possible use for the plants described even if they did represent a valid species. *S. viridiflora* grows in the Upper Sonoran life zone of the Great Basin and adjacent areas bordering the main chains of the Rocky Mountains. The plants are exceedingly abundant locally in western Wyoming where they are heavily grazed by sheep.

6. *STANLEYA CONFERTIFLORA* (Robinson) Howell, Fl. Northw. Am. 1:59 (1897)

S. viridiflora Nuttall, var. *confertiflora* Robins. in Gray, Syn. Fl. 1:178 (1895).

S. rara Nelson in Bot. Gaz. 52:262 (1911).

S. annua M. E. Jones in Contrib. Western Bot. 17:25 (1930).

Annual or biennial, glabrous throughout; stems single, erect, simple or rarely branched above, leafy, 3—8 dm. high; leaves all sessile, crowded, sagittate, glabrous, lanceolate, acute, entire, 4—16 cm. long, 1—4 cm. wide; inflorescence densely racemose, 1—4 dm. long; sepals linear-oblong, glabrous, lemon-yellow, spreading or reflexed at anthesis, slightly dilated at base, 8—12 mm. long, ca. 2 mm. wide; petals linear, lemon-yellow, glabrous, not markedly differentiated into blade and claw, very slender toward base, 1.5—2.5 cm. long, ca. 1 mm. wide; stamens exceeded by petals; filaments glabrous; nectar glands poorly developed, merely subtending the filaments in all cases; pedicels divaricate, glabrous, rather slender, 1—2 cm. long; siliques stipitate, terete, glabrous, erect, nearly straight, nerved from base to apex, 2—4 cm. long; gynophore slender, glabrous, 1—2 cm. long; style evident, 1—2 mm. long; seeds numerous, brown, wingless, oblong, plump, ca. 2 mm. long, ca. 1 mm. broad; cotyledons incumbent to obliquely accumbent.

IDAHO: Weiser, Washington Co., *M. E. Jones 6161* (NY,P,RM,UC,US); Big Willow, Canyon Co., May 1910, *Macbride 217* (RM type of *S. rara* A. Nels.).

OREGON: Huntington, June, 1930, *M. E. Jones 25317* (P type of *S. annua* Jones); Malheur Butte, Malheur Co., *Leiberg 2040* (G,US); Malheur Co., May, 1933, *Snowberger 14-A* (RM); Sheaville, Malheur Co., *Percy Train* (US); Base of Steens Mts., May, 1885, *Th. Howell 342* (G type, NY,Ph,UC,US isotypes).

P. confertiflora is a local species inhabiting adobe hills in the Upper Sonoran life-zone of southwestern Idaho and southeastern Oregon. It is most

closely related to *S. viridiflora*, but differs markedly in many ways. The plants are annual or biennial with sessile lower leaves, erect siliques, evident styles, and very long slender petals which are exceedingly reduced in width toward the base. In contrast, *S. viridiflora* is perennial with definitely petiolate basal leaves, arcuate siliques, sessile stigmas and relatively short petals which are very broad toward the base. Two species have been described which must be regarded as synonyms of *S. confertiflora*. The type of *S. rara* has an exceedingly long inflorescence and the petals are very slender indeed, but these are by no means distinctive characters and are easily included within the natural range of variation of *S. confertiflora*. *S. annua* does not differ particularly from typical specimens of the species to which it has here been referred.

SPECIES EXCLUDED

Stanleya gracilis DC., Syst. 2:512 (1821) = *Warea cuneifolia* Nutt., Journ. Acad. Philad. 7:84 (1834).

Stanleya washitana DC., ibid. = *Streptanthus maculatus* Nutt.?—certainly not *Stanleya*.

Stanleya? amplexifolia Nutt., Am. Journ. Sci. 5:297 (1822) = *Warea amplexifolia* Nutt.

Stanleya cartilaginea Spreng., Syst. 2:959 (1824) = *Sisymbrium junceum* Bieb.? It is certainly not a member of the genus *Stanleya*.

Notes on Plankton Flagellates from the Scioto River

(With Descriptions of New Forms)

JAMES B. LACKEY

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In an examination of several hundred plankton samples taken from the Scioto River system of Ohio during 1937-38, a number of apparently new species together with others probably unrecorded for the United States, or of limited occurrence, were found, and their distribution and seasonal occurrence noted. All of the flagellated Algae which occurred were studied, but this paper does not include notes on the Dinophyceae. It should be noted that no representative of the Chloromonadinae has thus far been found in the Scioto. The three free living orders of flagellated Protozoa comprising the Zoomastigoda were also represented, but only the Proto-mastigoda in abundance. Inasmuch as all these samples were taken in the current of the stream, the absence of bottom and attached forms is to be expected except for occasional invasions.

The location of the sampling points relative to pollution of the river is as follows:

Station 1, Columbus	Mile 0, Minimal pollution
Sewer outfall	" 3, Maximum "
Station 2, Shadeville	" 13, Heavy "
Big Walnut Creek	" 15, Unpolluted tributary
Station 3, Commercial Point	" 17, Heavy pollution
Station 4, South Bloomfield	" 23, Lessening pollution
Little Walnut Creek	" 27, Relatively clean tributary
Station 5, Red Bridge	" 30, Pollution, not marked
Darby Creek	" 32, Clean tributary
Station 6, Penn. Bridge	" 35, Some pollution from Circleville
Station 7, Kellenberger's Bridge	" 46, River relatively clean
Deer Creek	" 47, Clean tributary
Station 8, Chillicothe	" 60, River clean except some pollution from 2 large institutions
Station 9, Kilgour	" 67, River almost clean despite Chillicothe sewage
Paint Creek	" 68, Slightly polluted tributary
Station 10, Higby	" 76, River clean

Twelve genera and 21 species of Chrysophyceae have been found in the Scioto, the most common being the genus *Chrysococcus*. Smith (5) does not mention this genus, nor has any reference to it been found in other American literature reviewed by the author. Elsewhere (1) five new species are described, and another is included here. Although members of this genus are very small, their numbers, color, resistant shells and slow movement make them easy to discern. They appear to be highly characteristic of the Ohio and Tennessee River systems, and to be quite susceptible to organic pollution. *Chrysococcus asper*, the new species hereinafter described, like the other species of the genus, is adversely affected by pollution, and sometimes appears suddenly in large numbers.

Chrysopsis sagene Pascher has been identified a few times, but is very rare. Chromulina is represented by at least two species, *C. ovalis* Klebs which occurs largely in the winter months, and *C. globosa* Pascher (Fig. 1) most frequent in the late summer and fall. This large, slow moving species is easily identified by its knobbed appearance. Its distribution indicates no preference for either polluted or clean water. Mallomonas is represented by at least three species. *M. caudata* Iwanoff is common in the non-polluted areas; *M. akrokomos* Pascher and Ruttner is an unusual form which occurs sparingly during most of the year, but especially in the spring. One of the most beautiful small Chrysomonads is *Hymenomonas roseola* Stein (Figs. 2 and 3) most common in fall and spring. This American form differs from the one originally described by Stein in having oval or curved pits in its shell, instead of round ones. Its color is a golden brown instead of red. *Lagynion Scherffeltii* Pascher (Fig. 4) is a species which Smith (5) says has not been found in this country. It is, however, common in the Scioto at times, being epiphytic on *Cyclotella*, *Scenedesmus* and *Micractinium*. The shell is a transparent brown and has a much shorter neck than those figured by Pascher (2) or Smith, and is more rounded basally. Normally extended pseudopodia are one or two, rather long and unbranched. The chromatophores are two curved, golden brown bands.

Ochromonas, Synura, Uroglenopsis and Dinobryon are represented in the Scioto plankton by one or more species each, but none of them have ever been common. For Synura and Dinobryon this is perhaps unusual; Synura may be more favorable to a quiescent environment and in the winter when its numbers should be highest, the Scioto is frequently swift and turbid. But Dinobryon is sometimes common in Big Walnut Creek, a tributary of the Scioto, and in the Ohio, and its sparse occurrence in the Scioto is thereby more remarkable.

The organism described below as *Chrysochromulina parva* spec. nov., may have been present on previous occasions; its very small size makes it difficult to detect, but on several occasions an organism thought to be *Nephroselmis* sp. was carried in the counts simply as a "small flagellate" which is now believed to have been this one.

Seven of the 12 genera of Cryptophyceae have been found in the Scioto, three in abundance, and two in such numbers during much of the year that they share with *Chrysococcus* an importance as indicators of the sanitary condition of the stream. *Cryptochrysis commutata* Pascher has been tentatively identified a number of times, despite doubt as to whether the small organism in question has a median furrow, or whether this is sufficiently insunk to become the "gullet" of a small species of *Cryptomonas*. *Rhodomonas lacustris* Pascher and Ruttner (Fig. 5) is very common much of the year in the cleaner parts of the river and tributaries. Its chromatophore is pale brown rather than red, and a pyrenoid is questionable. The pellicle

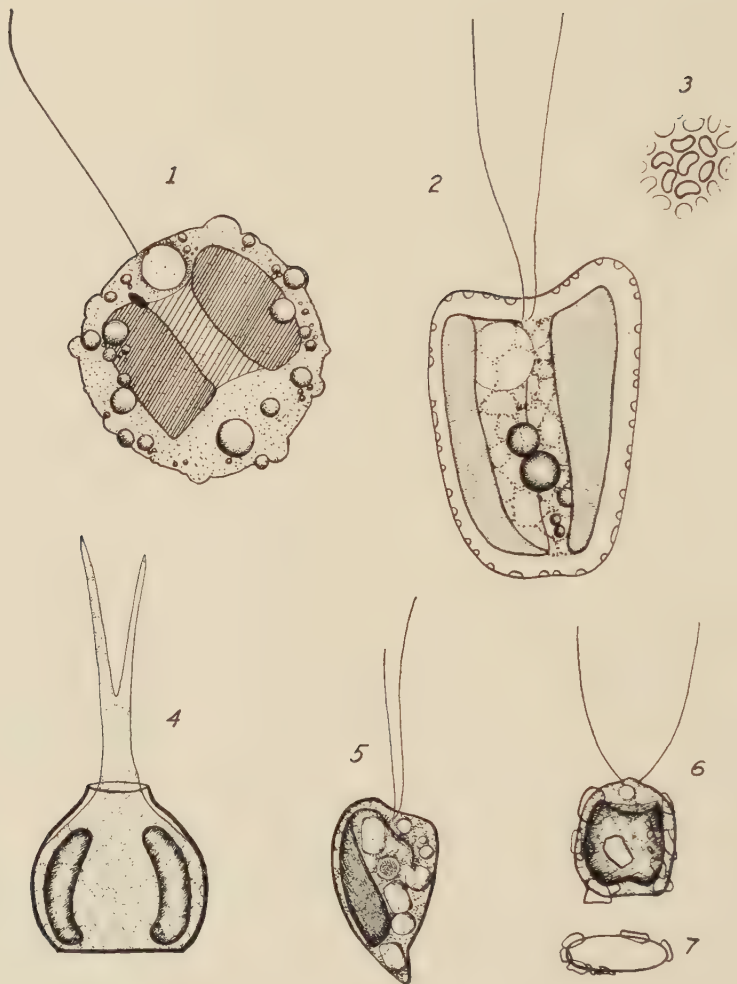


Fig. 1. *Chromulina globosa*. General structure.

Fig. 2. *Hymenomonas roseola*. Entire animal.

Fig. 3. *Hymenomonas roseola*. Pits in surface of shell.

Fig. 4. *Lagynion Scherffeltii*, showing chromatophores and pseudopodia.

Fig. 5. *Rhodomonas lacustris*. General structure.

Fig. 6. Probably *Thoracomonas* sp. Note absence of stigma and pyrenoid.

Fig. 7. Same, x-section showing attached sand grains.

is evidently firmer than that of *Cryptomonas*, and the animal retains its shape after formalin preservation. *Rhodomonas* varies but little in shape, size and color. It is quite susceptible to organic pollution, and is rarely found in the sewage laden waters of the Shadeville, Commercial Point and South Bloomfield stations, whereas enormous numbers occur at times at Columbus and Big Walnut.

Cryptomonas erosa is the most common of its genus. The organism varies rather widely in color, shape and size. Large specimens of *C. erosa* are probably not separable from *C. ovata* Ehrenberg or *C. maxima* Playfair. The largest specimens of *Cryptomonas* are collected at Columbus where they sometimes occur in abundance. They cannot be separated into *C. ovata* and *C. maxima*; intergradation of size and shape is complete; they are rare from Shadeville to Chillicothe. Apropos of the statements by Playfair (4) and Pascher and Lemmermann (2) concerning the variability of color in *C. ovata* and *C. erosa*, it is interesting to note that *C. erosa* of the Scioto River system is often red in the winter months, especially those of the tributary creeks.

Chroomonas is also abundant in the tributaries and occasionally in the river; it seems to be adverse to pollution. It is not preserved in recognizable state by formalin. Inasmuch as there is considerable variability of size and shape for these organisms, a re-examination of the genus is needed to determine just what species are valid. Those of the Scioto have not been classified as to species, however, because they were only counted in un-killed samples in which they were very active. *C. setoniensis* Lackey, *C. nordstetii* Hansgirg, and *C. cyaneus* Lackey were certainly present.

C. cyaneus Lackey is probably the same as *C. acuta* described by Utermohl (6) in 1925. Size, shape and general description show close agreement. *C. cyaneus* is apparently devoid of a pyrenoid, but this is not a constantly visible cell organelle for a given species; also, cell inclusions might be interpreted as pyrenoids. Therefore, it seems that *C. cyaneus* Lackey should be dropped in favor of *C. acuta* Utermohl.

Several unusual and one, possibly two new species of flagellated Chlorophyceae occur in the 23 genera of this group thus far found in the Scioto. Some of the 67 genera are very common as *Chlamydomonas*, in which little attempt at species identification has been made. *Mesostigma viride* Lauterborn is one of the rare forms for which no American record has been found. It has been most frequent in the tributary creeks, especially in the colder months, but it occurred in greatest numbers at the following river stations: Columbus, South Bloomfield, Chillicothe and Kilgour. Once recognized, it is easily distinguished by the conspicuous median stigma, shape and irregular, jerky movement.

Spermatozopsis exultans Korschikoff is another common summer form in both the Scioto and Little Miami Rivers. Forms with two flagella have

not been noted. The organism is easily studied as it often stays motionless for long periods. Other infrequently mentioned species common in the Scioto are: *Heteromastix angulata* Korschikoff; *Phacotus lenticularis* Ehrenberg; *Chlorogonium elongatum* Dangeard; *C. euchlorum* Ehrenberg; *Sphaerellopsis fluviatile* Pascher; *Wislouchiella planctonica* Skvortzow; *Lobomonas rostrata* Hazen (common only in Paint Creek, a polluted tributary); *Spondylomorum quaternarium* Ehrenberg; *Chlamydobotrys stellata* Korschikoff; *Gonium sociale* (Duj) Warming.

Chlamydobotrys and Spondylomorum are indistinguishable in practice; they must either be studied at a high magnification or crushed so as to show whether the zooids have two or four flagella.

Volvox aureus Ehrenberg has occurred in only one sample. *Pedinomonas maior* Korschikoff; *Thoracomonas irregularis* Korschikoff; *Lobomonas ampla* Pascher; *Coccomonas orbicularis* Stein (always with a deep brown shell); *Pteromonas aculeata* Lemmermann; and *Thoracomonas phacotoides* Smith have occurred rarely. The last named species from the Scioto may be actually a new one; it is more nearly round in outline, greatly flattened, and about 15 m. in diameter. These characters have been constant in those observed, and there has been no intergradation with a much more common form which corresponds quite closely to Smith's *T. phacotoides* except for the absence of brown color. Figures 6 and 7 show an organism which has also been common at times and whose possession of a shell is doubtful. It varies in size from 5 to 10 m., and while oval in outline, is strongly flattened. No shell can be detected, but there are numerous attached sand grains. One massive apple green chloroplast is present; a large median pyrenoid; one or two contractile vacuoles at the base of two widely separated equal flagella. There is no stigma. Such an organism is difficult to place, and while provisionally called *Thoracomonas*, cannot be definitely assigned to that group until its behavior in division is seen.

Another organism whose position is questionable is tentatively classified here as *Pteromonas cruciata* Playfair. Figures 8 to 16 inclusive show variations of the organism from the Scioto samples. No typical specimens of *Pteromonas cruciata* have been found, but Figure 8 closely approximates one of Playfair's (3) original figures except for the flattening of the organism and the roughness of the shell; however, the shell of *cruciata* is somewhat rough. Figure 8 also approximates *Wislouchiella planctonica* Skvortzow, except for the connection between the upper and lower processes, and the fact that they both extend out at the same angle instead of different angles. Specimens with unconnected upper and lower processes have been found (not figured here) and have shown variations in this angle relationship. Such specimens would belong to *W. planctonica*, while those similar to Figure 8 could be called *P. aculeata*. But varying degrees of process development, as well as of thickening of the body (Fig. 15) are easily found.



Fig. 8. *Pteromonas cruciata*, structural detail.

Fig. 9. Same, side view in outline.

Figs. 10-14. Same, showing observed variation in thickness and wings.

Figures 10 and 12 for example might readily be called new species, whereas the writer believes all of those figured represent the same species, probably *Pteromonas cruciata*.

One new member of the Volvocales, *Polytoma granulifera*, is described below.

The most abundant flagellate group in the river is the Euglenophyceae. Five genera of green members comprising about 56 species have been taken as suspended forms, while bottom samples are rich in the crawling colorless members of the order. The green representatives are most abundant in the late summer. Eighteen species of *Euglena* were certainly recognized and it is probable that other species could have been identified except for the rather poor taxonomic differentiation of this genus. One species, believed to be new, occurred consistently; the name *Euglena sciotosensis* is tentatively assigned to it. *Trachelomonas* is also abundant and again it is difficult to determine accurately the number of species present. In this case the difficulty is largely due to the intergradation between *Tr. scabra* var. *cordata* Playfair and *Tr. urceolata* var. *Girardiana* Playfair. All degrees of roundness and elongation could be shown in this group, and a number of species established except for the imperceptible intergradation of forms. By selecting individual specimens, it would easily be possible to identify the species *conspersa*, *bernardi*, *affinis*, *volgensis*, *acuminata*, *urceolata*, *fluviatilis*, *Schauinslandi*, *ensifera*, *caudata*, *triquetra* and others, together with varieties. This group and the species *crebea* are the only ones which are widely distributed in the Scioto; certain of these species sometimes appear in large numbers and over considerable periods of time. Other species are more apt to be present in large numbers at a single station on isolated occasions.

The genera *Lepocinclis*, *Phacus* and *Cryptoglena* are well represented in the Scioto plankton. Very few of the colorless forms appear in the counts unless bottom samples are taken; the only unusual forms which have been found are *Metanema variable* Klebs and *Peranema asperum* Playfair. This last organism is readily distinguishable from *Polytoma granulifera* because its heavy flagellum is easily seen, its movement is a constant and steady progression, while mouth to mouth fusion of two individuals has never been noted. Scioto River specimens have an outer coating of sand grains, however, not the amylaceous granules of Playfair's specimens. There appear to be no differences of specific value between his and Penard's *granuliferum*.

While many species of the animal flagellates occur occasionally in the Scioto plankton, the number of commonly occurring species is small. Several species of small colorless flagellates occur with some constancy, which have never been satisfactorily identified. Except for the occasional occurrence of *Multicilia lacustris* Lauterborn and *Dimorpha mutans* Gruber

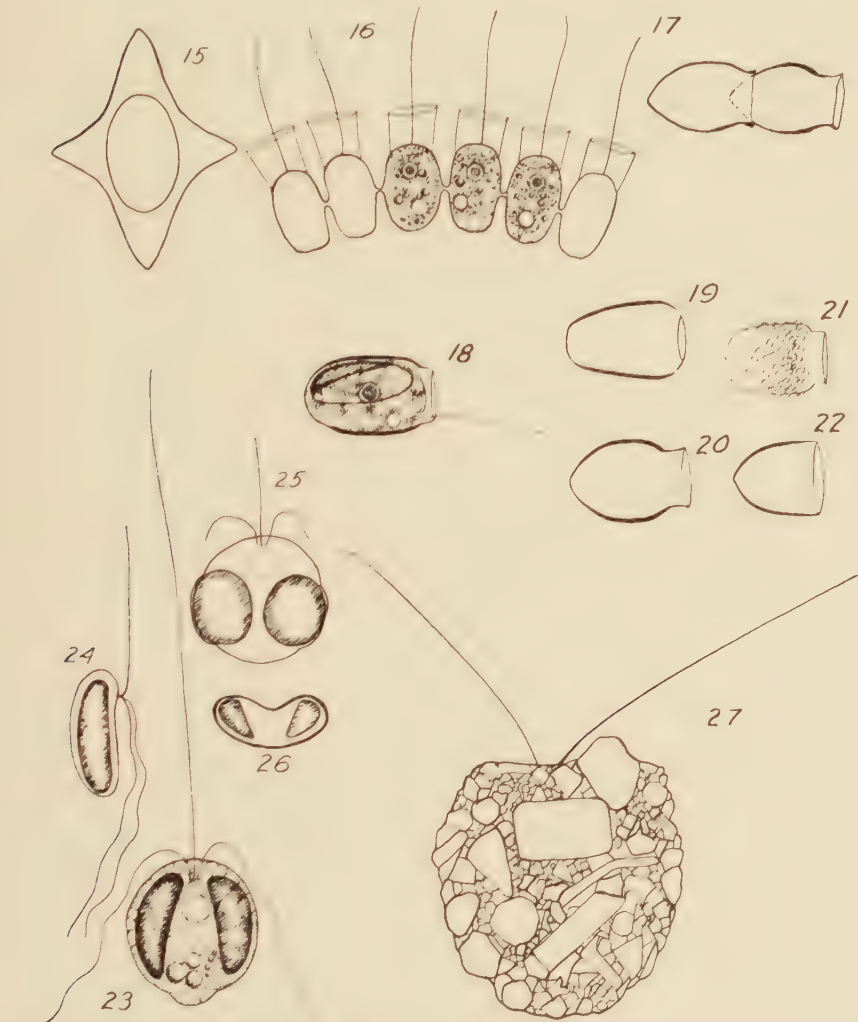


Fig. 15. *Pteromonas cruciata*, x-section of a thick individual.

Fig. 16. *Desmarella moniliformis*. General structure.

Fig. 17. *Chrysococcus aspera*, two shells suggesting method of formation of daughter cells

Fig. 18. Same, general structure.

Figs. 19-22. Same, shell types. Fig. 21 shows the characteristic roughening of the shell.

Fig. 23. *Chrysochromulina parva*. General structure. Note the long, often rigid, primary flagellum.

Fig. 24. Same, longitudinal section.

Fig. 25. Same, form with round chromatophores.

Fig. 26. Same, x-section showing median depression.

Fig. 27. *Polytoma granulifera*, shell and flagella.

of the Pantastomatida, and *Trepomonas rotans* and *Tetramitus rostratus* of the Polymastigida, those commonly found belong to the Protomastigida. *Oicomonas termo* S. Kent and *O. socialis* Moroff are common in the polluted parts of the river and are largely independent of seasonal fluctuations. *Bicoeca lacustris* J. Clark often occurs in huge numbers, attached to *Cyclotella*, *Micractinium* or some other planctonic alga. *Poteriodendron petiolatum* Stein is frequent, and was the most abundant monad in the activated sludge chambers of the new Columbus sewage treatment plant for a while. Its shell is very resistant. *Monosiga ovata* S. Kent and *Codonomosiga botrytis* S. Kent, while common, rarely attain great numbers. One of the most interesting monads is *Desmarella moniliformis* S. Kent (Fig. 17) which sometimes grows in chains of as many as thirty (30) individuals in the lower reaches of the river. *Salpingoeca brunnea* Stokes and *S. vaginicola* Stein are also common but not numerous. *Monas* is probably represented by a number of species, but *M. vivipara* is the most abundant, easily distinguishable by its size. No other species were identified because of the time necessary to make such determinations, and the fact that after formalin preservation, species identification is impossible. The two organisms described as *Codomonas annulata* spec. nov., and *Domatomonas cylindrica* spec. nov., have never occurred in large numbers. The former is very beautiful; its brown shells are quite resistant. While the empty shells are occasionally found in the heavily polluted reaches of the river, the organism is apparently unfavorable to pollution. *Domatomonas*, on the contrary, has shown a distinct tendency to occur most abundantly in polluted zones.

Table one gives a list of the flagellate species identified to date, including the new species. It is given simply to record species for which either Ohio Valley or American records may be lacking, and as a summary of the findings shown by this paper.

***Chrysococcus asper* spec. nov.**

Figs. 17-22.

Cellulae solitariae, libere natantes, ovatae sed forma variabiles, apice truncata, basi rotundata, membrana in media parte scabra; colore dilute fusco; chromatophora singula, luteo-fusca; flagello singulo, vesicula contractili singula; cytoplasmate hyalino sine inclusionibus. Cellulae long. 8—12 μ ; lat. 5—8 μ .

This species has been very common at times. Its shape varies slightly, especially in the thickening of the shell and its depth of color. The organism almost fills the shell, is not stalked, and has a single flagellum about 5—8 μ long. Because of the usual anterior constriction of the shell and because the flagellum is not polar in emergence but arises near the lip of the shell, the organism was thought to be *Kephyriopsis ellipsoidea* Pascher and Ruttner. Abundant material however definitely showed but one flagel-

lum and because mouth-to-mouth fusion of two individuals as shown (Lackey, 1) for other species of *Chrysococcus* has been repeatedly seen, it is classified as a species of *Chrysococcus*. There is a single large peripheral, irregularly discoidal chromatophore, light yellow brown. A small contractile vacuole is near the flagellum base. Reproduction by apparent transverse fission with formation of a new shell before the zooid leaves the parent shell, has been seen. No cysts have been found.

***Chrysochromulina parva* gen. nov., spec. nov.**

Figs. 23-26.

Cellulae minutae, rotundatae, parte infera leviter excavatae, forma plus minusve variables; chromatophoris 2, in lateribus dispositis, colore luteo-fusco; vesicula contractili singula, anteriore; stigmatibus nullo; plasmate granulas parvas in posteriore parte praebente; flagellis 3, uno primario crassiore longiore ad anteriorem directo, secundariis duobus tenuioribus, brevioribus ad posteriorem directis. Cellulae lat. 3—5 μ ; crass. 2—3 μ .

Possibly seen many times, this minute flagellate was finally studied at a magnification of 1125 x when its numbers reached 2500 per ml. in Big Walnut Creek on October 13, 1938. Viewed vertically the cell is generally rounded, sometimes with a small posterior lobe. In cross section, the ventral surface is slightly insunk, but there is no gullet. This characteristic is slightly variable. The cytoplasm is clear and if there is a membrane, it is thin. Posteriorly a few small round refringent granules are located. No nucleus or stigma were seen. There is a simple vacuole in the anterior end behind the point of emergence of the flagella. Two chromatophores, peripheral, curved, of smooth contour and golden brown in color, are present. There are three flagella, the anteriorly directed one is the heavier, 5 to 8 times as long as the cell and held rigid when the organism is at rest. Its beat is too fast to be determined in the rapid swimming motion. Two posteriorly directed, slightly shorter and more tenuous ones are present; often when at rest these are kept gently undulating. No evidence of reproduction was seen. Nutrition is evidently holophytic. Its distribution on October 13 and 21, 1938, was as follows:

Nos. per ml. at River miles	Columbus	Shadeville	Big Walnut	Commer- cial Point	South Bloomfield	Penn Bridge	Chillicothe
Sept. 29, 1938	3	10	10		10	10	20
Oct. 13, 1938			2500			200	
Oct. 27, 1938	90	0	50	50	150	110	30

The classification of this flagellate is difficult. Its color, lack of a gullet and motility place it in the class Chrysophyceae. But its three flagella exclude it from the accepted families and necessitate setting up a new

family, for which the name **Chrysochromulinidae** is proposed. The abundance and persistence of the organism and its appearance in other tributaries of the Scioto River would indicate that it is not a stage in the life history of some other organism.

***Polytoma granulifera* spec. nov.**

Figs. 27-28.

Testa globosa granulis arenaceis ubique asperrima; contentu invisio sed olim in parte anteriore; flagellis 2, aequalibus; vesiculis contractilibus ad basim flagellorum duabus, aliquando pluribus; stigmatе nullo; diam. ca. 15μ .

These organisms first appeared in large numbers in Big Walnut Creek, then spread gradually downstream. With a test of very irregular sand grains, they appeared to be very black and were at first thought to be a small rhizopod. Then they were seen to swim rapidly and finally fusion of individuals was noted.

The body is fairly uniform in size, rarely reaching 20μ in diameter. Often the sand grains are quite heavy, but those obtained far down the river from Big Walnut Creek tended to have fewer granules attached, perhaps because they were worn off in transit. The flagella are about 15μ long and equal. Rarely the anterior end of the animal protrudes, and the two flagella are seen to emerge at an angle. At their base two or more simple vacuoles are formed. Granules, presumably starchy, may be seen, especially if the animal is squeezed so that the cytoplasm protrudes from the shell. There is no stigma nor has oil been seen.

It may be questioned whether this organism should be given species rank. The membrane of *P. uvella* Ehrenberg is known to have a granular investment (Pascher, A.: Die Süsswasserflora—Heft 4 Volvocales—Phytomonadinae, p. 380, 382) but in this case there seems to be a definite shell present, and specific rank is proposed.

***Euglena sciotensis* sp. nov.**

Figs. 29-30.

Cellulae fere rigidae, cylindratae, sed in parte posteriore leviter inflatae; apice oblique truncata, basi attenuata, membrana hyalina, glabra, spiris minutis; stigmatе magno; pharynge distincta; chlorophoris paucis, magnis, orbiculatis sine pyrenoidibus; nucleo centrali, flagello longo; granulis amylaceis fere semper duabus majoribus, pluribus minoribus; corp. long. $35-40$, lat. $5-7\mu$.

A very small *Euglena* of the oxyuris type, scarcely metabolic, but without the thick pellicle of the larger forms. No visible striations. Broadly rounded anteriorly with a slight constriction behind the anterior end; cylindrical, pointed posteriorly. The gullet and reservoir are distinct, the flagellum is short and tenuous and there is a conspicuous stigma. The

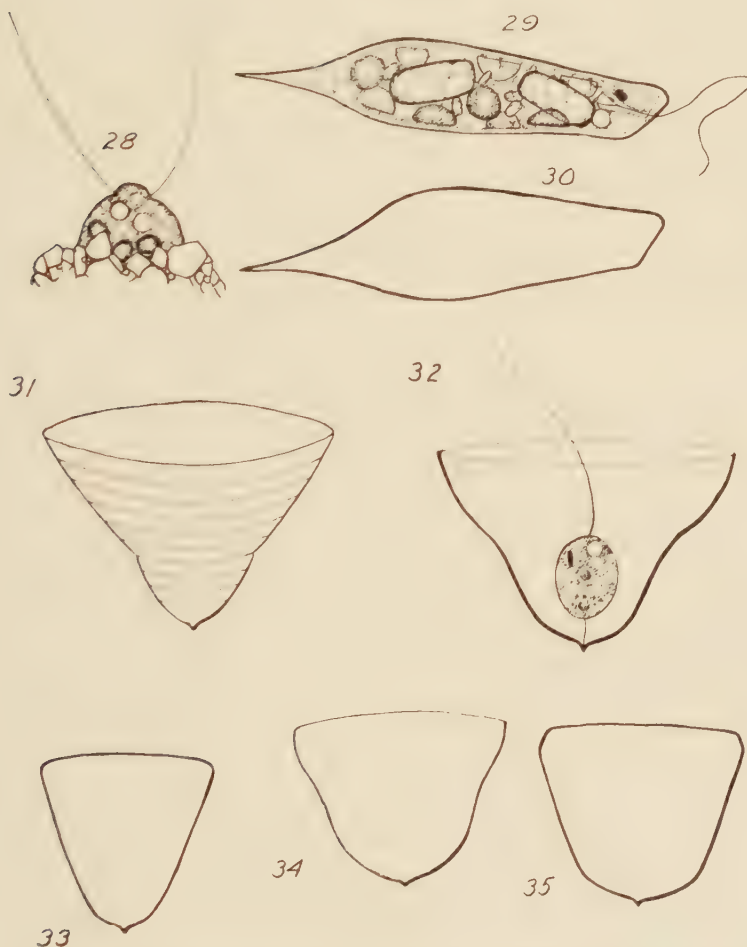


Fig. 28. *Polytoma granulifera*, zooid partly extruded showing papilla, vacuoles and starch granules.

Fig. 29. *Euglena sciotensis*, general structure. About half the chloroplasts are omitted.

Fig. 30. Same, frequently observed shape.

Fig. 31. *Codomonas annulata*, shell with annular rings.

Fig. 32. Same, structure and attachment of zooid.

Figs. 33-35. Same, shell types.

round disciform chloroplasts are few in number, parietal in disposition, nucleus median. Two types of paramylum, a few small rods, and two larger rectangular plates.

This probably is nearest Walton's (7) *E. simulacra* but differs in size, in possessing two types of paramylum granules, in the size of the chloroplasts and in the somewhat clavate anterior end, which is quite diagnostic for the organism.

Codomonas annulata, gen. nov., sp. nov.

Figs. 31-36.

Cellulae solitariae, libere natantes, sub-ovales vel globosae cum cauliculo brevi contractili; testa late campanulata, dilute fulva, annulata, hyalina, gracili; nucleo centrali, vesicula contractili ad basim flagelli; flagello singulo, longo, tenui; plasmate decolorato, granulato, vesiculis cibariis; diam. cellulae 6-10 μ , diam. loricae 16-20 μ , long. loricae 15-20 μ .

This organism has a bell shaped test whose mouth varies slightly in diameter, so that the lip may be either incurving or flaring. The shell is smooth, almost colorless in presumably young individuals, or golden brown in others, translucent and encircled by from 9 to 15 small depressions, giving it a ringed appearance. The animal is attached to its apex by a short contractile stalk. In shape spherical or slightly oval, the monad is colorless, with a few food vacuoles, one contractile vacuole near the base of the flagellum which is about 15-20 μ long. There is a median nucleus and a few spherical bodies in the cytoplasm. Nutrition holozoic.

The absence of a collar or peristome and the presence of a single flagellum refer this organism to the Oicomonadaceae. It fits into neither of the genera with tests hence a new genus is created for it. It is of striking beauty, easily distinguished and seems common to both the Scioto and Little Miami Rivers.

Domatomonas cylindrica gen. nov., spec. nov.

Figs. 37-38.

Lorica cylindrata, 30 μ longa, 12 μ lata, apice hianti, basi rotundata, externe granulis parvis subtiliter asperrima, decolorata; cellula globosa vel subglobosa, 10 μ diam., decolorata, cauliculo brevi contractili; flagello singulo, 30 μ longo, vesicula contractili in posteriore parte, nucleo centrali; cytoplasmate granuloso.

The lorica of this animal is colorless, almost transparent and thin. It is ornamented externally with minute granules of sand or débris. The anterior end is entirely open, transversely, and the posterior end rounded. The body of the animal is spherical or ovate, with a long anterior flagellum and a short posterior stalk which is contractile. A single contractile vacuole is posterior, a small nucleus is median and there are small bodies in the cytoplasm which could be food, but it is not known to be holozoic. The different

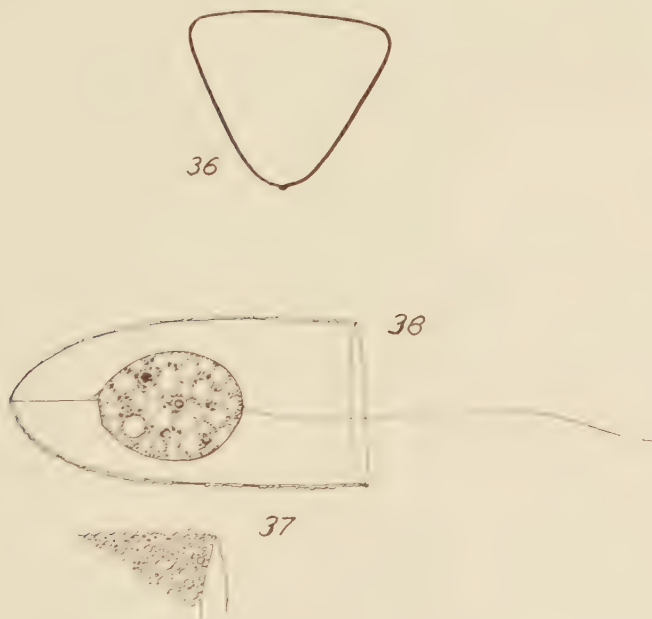


Fig. 36. *Codomonas annulata*, shell type.

Fig. 37. *Domatomonas cylindrica*, detail of outer surface of shell.

Fig. 38. Same, structure and attachment of zooid.

type of shell and location of the contractile vacuole distinguish it from the preceding organism, but it also is placed in the Oicomonadaceae. No reproduction was seen.

This organism and the preceding are good but slow swimmers. This one is more easily overlooked because of its transparency, but is large enough to be unmistakable in structure. It has also been taken in the Little Miami River.

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	Occurrence Frequent	Occurrence Rare	Numbers Sometime Large		Occurrence Frequent	Occurrence Rare	Numbers Sometime Large
ALGAE				ALGAE (Continued)			
<i>Chrysophyceae</i>				<i>Euglenophyceae</i> (Continued)			
Chrysopsis sagene	x			Euglena fusca	x		
Chromulina ovalis		x	x	“ spirogyra		x	
“ globosa	x			“ mutabilis		x	
Chrysococcus punctiformis		x	x	“ deses	x		
“ rufescens	x	x		“ polymorpha	x		
“ major		x		“ gracilis		x	
“ ovalis	x	x		“ agilis		x	
“ hemisphaerica		x		“ sciotensis	x		
“ cylindrica		x		Lepocinclis ovum	x		
“ amphora		x		“ texta	x		
“ spiralis	x	x		Phacus longicauda	x		
“ asper	x	x		“ anacoleus	x		
Chrysopyxis bipes		x		“ orbicularis		x	
Mallomonas caudata	x	x		“ pleuronectes	x		
“ akrokomos		x		“ triqueter	x		
Hymenomonas roseola		x		“ acuminata		x	
Synura uvella		x		“ brevicaudata		x	
Ochromonas sp.		x		“ Stokesii		x	
Uroglenopsis americana		x		“ pyrum	x		
Dinobryon sertularia	x			“ striata		x	
Lagynion Scherffellii	x			Trachelomonas volvocina	x		
<i>Cryptophyceae</i>				“ minor		x	
Rhodomonas lacustris	x	x		“ oblonga var.			
Chroomonas pulex	x	x		“ scrobicula		x	
“ nordstii	x	x		“ euchlora	x		
“ cyaneus	x	x		“ crebea	x		x
“ setoniensis	x	x		“ conspersa	x		x
Cryptomonas erosa	x	x		“ hispida		x	
“ ovata	x	x		“ eurystoma		x	
Chilomonas paramecium		x		“ caudata	x		
Cyathomonas truncata		x		“ affinis		x	
Nephroselmis olivacea		x		“ cuneata	x		
<i>Euglenophyceae</i>				“ volgensis		x	
Euglena viridis	x	x		“ Girardiana	x		
“ pisciformis	x	x		“ urceolata	x		x
“ sociabilis	x	x		“ gibberosa		x	
“ sanguinea	x			“ fluviatilis	x		x
“ variabilis	x			“ Schauinslandi		x	
“ Ehrenbergii	x			“ ensifera		x	
“ acus	x	x		“ acuminata	x		x
“ spiroides	x			“ ovoides		x	
“ oxyuris	x			“ australis		x	
“ torta	x			“ scabra	x		x
“ tripteris	x			Cryptoglana pigra		x	x

	Occurrence Frequent	Occurrence Rare	Numbers Sometime Large		Occurrence Frequent	Occurrence Rare	Numbers Sometime Large
ALGAE (Continued)				ALGAE (Continued)			
<i>Euglenophyceae</i> (Continued)				<i>Chlorophyceae</i> (Continued)			
<i>Astasia Klebsii</i>		x		<i>Polytoma granulifera</i>	x		x
“ <i>Dangeardii</i>		x		<i>Volvocinae</i>			
<i>Peranema trichophorum</i>	x			<i>Spondylomorom quater-</i>			
“ <i>granulifera</i>		x	x	<i>narium</i>		x	x
“ <i>ovalis</i>	x			<i>Chlamydotrys stellata</i>		x	x
<i>Menoidium incurvum</i>		x		<i>Gonium pectorale</i>	x		x
<i>Urceolus sabulosus</i>		x		“ <i>socialis</i>		x	
<i>Petalomonas mediocanellata</i>	x			<i>Pandorina morum</i>	x		x
“ <i>carinata</i>		x		<i>Eudorina elegans</i>	x		x
<i>Scytomonas pusilla</i>	x			<i>Volvox aureus</i>		x	
<i>Heteronema acus</i>		x		PROTOZOA			
<i>Notosolenus apocamptus</i>		x		<i>Zoomastigoda</i>			
“ <i>orbicularis</i>	x			<i>Pantostomatinae</i>			
<i>Anisonema ovale</i>	x			<i>Multicilia lacustris</i>		x	
“ <i>emarginatum</i>		x		<i>Cercobodo longicauda</i>		x	
<i>Entosiphon sulcatum</i>		x		<i>Dimorpha mutans</i>		x	
<i>Metanema variabile</i>		x		<i>Protomastiginae</i>			
<i>Chlorophyceae</i>				<i>Codomonas annulata</i>	x		x
<i>Volvocales</i>				<i>Oicomonas termo</i>	x		x
<i>Polyblepharidinae</i>				“ <i>socialis</i>	x		x
<i>Pyramidomonas inconstans</i>		x		<i>Domatomonas cylindrica</i>	x		
<i>Spermatozopsis exultans</i>	x		x	<i>Bicoeca lacustris</i>	x		x
<i>Mesostigma viride</i>		x	x	<i>Poteriodendron petiolatum</i>	x		x
<i>Pedinomonas maior</i>		x		<i>Monosiga ovata</i>	x		
<i>Heteromastix angulata</i>	x		x	<i>Codonosiga botrytis</i>	x		
<i>Chlamydomonadinae</i>				<i>Desmarella moniliformis</i>	x		x
<i>Chlamydomonas</i> spp.	x		x	<i>Salpingoeca brunnea</i>		x	
<i>Chlorogonium euchlorum</i>		x		“ <i>vaginicola</i>		x	
“ <i>elongatum</i>		x		<i>Monas vivipara</i>	x		x
<i>Sphaerellopsis fluviatilis</i>		x		“ <i>vulgaris</i>	x		x
<i>Thorakomonas phacotoides</i>	x			<i>Dendromonas laxa</i>		x	x
“ <i>irregularis</i>			x	<i>Anthophysa vegetans</i>	x		x
<i>Wislouchiella planctonica</i>	x			<i>Bodo caudatus</i>	x		
<i>Platychloris minima</i>		x		“ <i>globosus</i>	x		x
<i>Lobomonas rostrata</i>		x		“ <i>angustus</i>		x	
“ <i>ampla</i>		x		<i>Pleuromonas jaculans</i>		x	
<i>Coccomonas orbicularis</i>		x		<i>Cladomonas fruticulosa</i>		x	
<i>Phacotus lenticularis</i>	x		x	<i>Tetramitus pyriformis</i>		x	
<i>Pteromonas aculeata</i>		x		<i>Distomatinae</i>			
“ <i>cruciata</i>		x		<i>Hexamitus crassus</i>		x	
<i>Polytoma uvella</i>		x		<i>Trepomonas rotans</i>		x	

Descriptions of New North American Species and Subspecies of *Myrmica* Latreille (Hym.: Formicidae)

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The descriptions of the following new *Myrmicas* are taken from a general revision of this genus in order to validate their names in studies by several students of ants which have appeared since 1935. Drawings, keys, ecological and other biological information, and locality lists of these forms are included in the revision. The members of this genus vary considerably, even within the same colony. Probably for this reason in large part only one form has been described from North America in over 30 years. Variation is particularly noticeable in the worker caste and it should be emphasized that frequently no satisfactory determination can be made of specimens unless at least the male caste is present with workers from the same nest. Identification of single specimens of *Myrmica* is therefore likely to be as unsatisfactory as identification of single workers of some species of genera such as *Crematogaster*, *Formica* and *Campanotus*.

Cotypes of these forms are in my collection and the Museum of Comparative Zoology.

***Myrmica sabuleti* Meinert ssp. *americana* n. ssp.**

Worker: Length 4.6—6.2 mm.

Antennal scape exceeding posterior margin of head by a distance equal to its distal diameter; seen from above, when the scape is extended posteriorly towards the mid-occiput, the lateral margin (towards the eyes) is sigmoid, the medial margin nearly straight and the distal end distinctly turned medially, this end $\frac{1}{3}$ larger in diameter than the proximal end. Proximal end of scape joined to the head by a right-angled bend, the latter with a nearly vertical, high lamina which is prolonged a trifle along the sides; lamina, viewed postero-medially, in the form of an acute tooth or keel; joints 1 and 2 of the funiculus together distinctly longer than 3—5 together. Thorax, in profile, slightly convex, with distinct and rounded mesoepinotal suture; epinotal spines, from the side, distinctly longer than the declivity ventral to them, projected upwards and backwards at about a 55° angle; seen from above, moderately diverging, about $\frac{1}{2}$ longer than the distance between their bases. Petiole, in profile, with concave anterior face meeting the dorsal convex surface at a rounded angle, as long from apex of ventral tooth to postpetiole as it is high; postpetiole, in profile, with nearly plane ventral surface and convex dorsum, as high as long. Gaster ovate. Legs of moderate length.

Surface of head regularly and moderately sculptured; frontal area distinct, finely striate-punctate; clypeus with 10—14 rugae; median dorsal region with regular, comparatively close-set, rugae which diverge to the

posterior angles; posterior surface reticulate, lateral surfaces rugose-reticulate. Thorax coarsely and sharply rugose, slightly vermiculate dorsally. Petiole dorsally with deep, irregular, vermiculations, laterally deeply and more regularly rugose; postpetiole rugose, dorsally somewhat concentrically rugose. Surfaces of body, except gaster, punctate at the base of the sculpturing. Gaster smooth and shining.

Pilosity moderate; hairs coarse, truncate or acute; appendages with moderately coarse, subappressed hairs; no pubescence on legs.

Color of head brown, of thorax and appendages ferruginous, gaster dark brown, lighter apically.

Female: Length 5.2—7 mm.

Similar to the worker and with equally high lamina on the antennal scape, the latter prolonged slightly more on the medial margin.

Differing in the following: Epinotal spines shorter than the declivity ventral to them, stout and bluntly tipped. Petiole, in profile, with faintly concave anterior face, slightly longer from apex of ventral tooth to postpetiole than it is high. Postpetiole with plane ventral and convex dorsal surface, distinctly higher than long.

Sculpturing of the head less regular. Pronotum at the sides deeply vermiculate-rugose, reticulate only at the very anterior margin; posterior sides of thorax evenly rugose; scutum of mesonotum with elongate antero-median smooth area from which radiate fairly even rugosities, somewhat vermiculate on the sides. Pedicel deeply sculptured as in the worker.

Pilosity moderately abundant, partly truncate, partly acute; legs with appressed hairs but without pubescence.

Color of head ferruginous, brownish mid-dorsally; thorax ferruginous with two elongate parapsidal brown blotches on the mesonotum; remainder of body and appendages ferruginous, gaster with a brown transverse, medial band. Wings hyaline with a brownish cast; veins brown.

Male: Length 5.2—6.6 mm.

Antennal scape subcylindrical, somewhat larger in diameter distally, evenly bent at a slight angle at the basal $\frac{1}{4}$, equal in length to from 4—5 of the following segments together; funicular club indistinctly 4—5 jointed. Epinotal declivity armed dorsally with two distinct subacute or rounded tubercles. Petiole, in profile, with plane anterior face and convex dorsal surface; postpetiole, in profile, $\frac{1}{4}$ higher than the petiole, dorsal surface convex, ventral surface nearly plane to slightly convex. Sagittae of the genitalia with 25—31 serrations.

Surface of head shining, with comparatively numerous rugae, punctate at the base of the sculpturing; thorax shining, abundantly rugose-striate except on the largely smooth scutum of the mesonotum, punctate at the base of the sculpturing; petiole thinly but distinctly rugose, finely punctate basally; postpetiole and gaster smooth and shining.

Pilosity moderately abundant, acute, fine. Appressed pubescence on the antennae and legs.

Color of head blackish brown, remainder of body and appendages dark brown; pedicel and base of gaster, antennal club and tarsi lighter brown. Wings hyaline with a brownish cast; veins brown.

Described from two colonies taken by W. M. Wheeler at Colebrook, Connecticut, August 16 and 24, 1904. This subspecies has a wide distribution in the United States and I have taken it in such representative states as Massachusetts (Blue Hills, Newton, Woods Hole); Pennsylvania (Towanda); North Dakota (Grand Forks, Bismarck, Towner, Mercer, Stanton, Grassy Butte); Colorado (Cebolla); and Utah (Bryce Canyon). I have also taken it in Manitoba (Wawanesa, Sidney).

Many workers of this subspecies and *fracticornis* Emery cannot be separated satisfactorily without the additional evidence of the males. The higher lamina or keel of the scape and its prolongation distally, with the comparatively flat ventral surface of the postpetiole, readily separates most of the *americana* workers from the corresponding slight transverse keel and convex ventral postpetiolar surface in *fracticornis*; there are specimens, however, which combine a high keel on the scape with a distinctly convex postpetiole, or a slight keel with a nearly flat ventral surface of the postpetiole. These may be considered transitional in the absence of the males.

The worker is readily separated from the worker of the subspecies *nearctica* by the shorter distal extension of the keel on the scape and the higher and thinner transverse portion; the ventral surface of the postpetiole is also nearly plane instead of distinctly convex. The males can be readily separated from those of *nearctica* by the longer antennal scape and distinct epinotal tubercles.

This variety, on the whole, is larger, paler and an inhabitant of warmer and dryer situations than either the subspecies *nearctica* or *fracticornis*.

***Myrmica sabuleti* Meinert ssp. *hamulata* n. ssp.**

Worker: Length 3.9—5.2 mm.

Antennal scape, extending barely to the occipital margin; seen from above, when extended posteriorly towards mid-occiput, the lateral margin is feebly sigmoid, the medial margin more distinctly sigmoid, produced in a distinct bend laterally at the distal end and inwardly, or medially, at the proximal end; this end with a conspicuous high, thin, lamina extending completely around it and produced medially in an acute hook; proximal end of scape joined to the head by a right-angled bend from which the lamina projects medially as a large, acute tooth; antennal club quite distinctly 3-jointed, last segment nearly as long as the two preceding together. Thorax, in profile, convex, with a shallow, obtuse mesoepinotal

suture; epinotal spines, in profile, extending upwards and backwards at a 45° angle, longer than the declivity ventral to them, slender, acutely pointed; from above, moderately diverging, about $1\frac{2}{3}$ longer than the distance between their bases. Petiole, in profile, with anterior face barely concave, meeting the dorsal surface at about a 100° rounded angle, a little higher than the distance between the apex of the ventral tooth and the postpetiole; postpetiole, in profile, with convex dorsal and ventral surfaces, about $\frac{2}{3}$ as long as high. Gaster ovate. Legs of moderate length.

Surface of the head rather deeply sculptured, several mid-dorsal rugae bounded by vermiculations, becoming reticulate on the sides and posterior surface. Surface of the thorax deeply vermiculate longitudinally, sides more rugose. Petiole deeply vermiculate; postpetiole more rugose, with a narrow mid-dorsal longitudinal band of fused rugae. Gaster smooth and shining. Base of the sculpturing not distinctly punctate.

Pilosity moderately abundant, dorsal hairs mostly truncate; subappressed hairs on the legs; no pubescence.

Color of body dark brown with head and gaster nearly black; appendages brown; hairs bright yellow.

Female: Length 4.9—5.7 mm.

Similar to the worker, with the following differences: Lamina of the antennal scape more erected proximally and the hook projected somewhat downward. Epinotal spines shorter than the declivity ventral to them, bluntly tipped. Anteromedian triangular area of the scutum of the mesonotum smooth and shining, from which extend several rugae posteriorly and a moderate number of lateral rounded vermiculations.

Color largely dark brown dorsally and more ferruginous on the sides and appendages. Wings hyaline; veins pale brown.

Male: Length 4.2—5 mm.

Antennal scape equal in length to from 2—3 of the following joints together, bent at the basal $\frac{1}{3}$ and incrassate immediately distal to the bend; funicular club indistinctly 5-jointed. Epinotal declivity with two distinct dorsal tubercles. Petiole, in profile, with dorsal surface convex, as long from apex of the slight ventral tooth to postpetiole as it is high; postpetiole nearly $1\frac{1}{2}$ times as high as long, dorsally and ventrally convex. Sagittae of the genitalia with 19—22 serrations.

Sculpturing of head sparsely and feebly rugose, densely punctate. Dorsal surface of thorax shining, sparsely and feebly rugose, sides more coarsely rugose and punctate. Petiole punctate, with a few feeble rugae; postpetiole and gaster smooth and shining.

Pilosity moderately abundant, acute and fine, subappressed on the appendages.

Color moderately dark brown, head and gaster somewhat darker; wings hyaline, veins pale brown.

Described from a colony of all castes taken by W. M. Wheeler at Hayne's Canyon, 8,000 feet, Sacramento Mts., New Mexico, July 3, 1917.

This extreme form of *sabuleti* may be separated readily from the subspecies *nearctica* and *americana* by the shorter antennal scape in the male and, in the workers and females, by the unusual prolongation of the lamina of the scape into a hook on the medial surface.

***Myrmica sabuleti* Meinert ssp. *nearctica* n. ssp.**

Worker: Length 3.4—4.4 mm.

Frontal carina comparatively large, auriculate and erect. Antennal scapes barely exceeding posterior margin of head; seen from above, straight, subcylindrical, bent slightly outwards distally; with a thickened, subopaque lamina extending the entire distance around the bend and along the medial margin (when the scape is extended posteriorly towards mid-occiput) fully a third the length of the scape, the lamina slightly raised at the bend but horizontal along the medial margin and even with the dorsum of the scape, the scape at the bend thickened in diameter; scape, from a posteromedial view, much thickened at the bend, which is nearly right-angled, narrow and compressed immediately distal to the bend, normally shaped at the distal $\frac{2}{3}$; joints 1 and 2 of the funiculus together about $\frac{1}{5}$ shorter than joints 3—5 together. Thorax, in profile, convex, evenly and distinctly impressed at the mesoepinotal suture; epinotal spines, in profile, slender, acute, with apices upturned, directed upwards and backwards at a 55° — 65° angle, a little shorter than the declivity ventral to them; from above, slightly longer than the distance between their bases, widely diverging. Petiole, in profile, with slightly concave anterior face meeting the nearly flat dorsal surface at a rounded right angle, about as long from apex of ventral tooth to postpetiole as it is high; postpetiole, in profile, with distinctly convex ventral surface, produced anteriorly, and convex dorsal surface produced posteriorly; nearly twice as high as long. Gaster ovate. Legs moderately long and slender.

Surface of head largely reticulate-vermiculate, with few longitudinal rugae on the mid-dorsal surface; frontal area distinct, smooth and shining except for sparse punctures. Dorsal surface of thorax coarsely reticulate-vermiculate, mostly reticulate, sides coarsely rugose, vermiculate anteriorly. Petiole moderately vermiculate dorsally, more regularly rugose laterally; postpetiole shallowly rugose, smooth and shining on a mid-dorsal longitudinal area. Base of sculpturing on body, except on gaster, abundantly punctate. Gaster smooth and shining.

Pilosity moderate, comparatively fine, hairs truncate or acute; legs with subappressed hairs; no pubescence.

Color of head from ferruginous to dark brown, thorax also variable but lighter, gaster dark brown, appendages ferruginous to brown.

Female: Length 5—5.7 mm.

Similar to the worker, with the following differences: Lamina of the scape especially at the bend, somewhat raised. Epinotal spines a little shorter and blunter, pointed downwards slightly.

Sculpture of head more regularly rugose. Sides of thorax rugose, anterior margin of pronotum vermiculate-reticulate; scutum of mesonotum with an anterior triangular smooth area, posteriorly followed by several rugae and, laterally, by rounded, open vermiculations. Pedicel deeply rugose, more vermiculate dorsally.

Pilosity moderately abundant, finer and subappressed on the gaster; subappressed hairs on the legs; no pubescence.

Color of head ferruginous, infuscated dorsally; thorax lighter ferruginous, mesonotum with distinct anteromedian and parapsidal brown blotches, several median blotches on the sides; pedicel and appendages light ferruginous; gaster dark brown, wings hyaline; veins light brown.

Male: Length 4.3—4.7 mm.

Antennal scape subcylindrical, slightly incrassate towards the middle, $2\frac{1}{2}$ times as long as wide, shorter than the 3 following segments of the funiculus together; antennal club 4-jointed; epinotal declivity armed dorsally with two low and indistinct tubercles. Petiole a little longer from apex of ventral tooth to postpetiole than it is high, evenly convex above; postpetiole $1\frac{1}{2}$ times as high as long, convex dorsally, less convex ventrally, slightly higher than the petiole. Sagittae of the genitalia with 21—24 teeth. Gaster ovate. Legs moderately long and slender.

Surface of head somewhat shining, thickly punctate, with sparse, low, rugae. Scutum of mesonotum mostly smooth and shining; sides thickly punctate, margins sparsely rugose; petiole finely punctate; postpetiole and gaster smooth and shining.

Pilosity moderate, erect, coarse, and truncate on the head, thorax and appendages, otherwise largely fine and acute; no pubescence.

Color brown, dark brown on the head. Wings hyaline; veins whitish to brown.

Described from colonies taken by myself 14 miles southwest of Towner, North Dakota, June 5, 1932 (type colony and locality) and at Wawanesa, Manitoba, July 2, 1933. Syntype colonies were taken by W. M. Wheeler at Cheyenne Canyon and Buena Vista, Colorado. My colonies were both in the woods along the Souris or Mouse River, which drains eventually to Hudson Bay. September 5, 1937 the exact locality of the Dakota collection was revisited and a small colony of this subspecies found. This subspecies is widely distributed in North Dakota as evidenced by the following records: Chaffee, Hunter (C. Schonberger); Grand Forks (L. Monda, N. A. Weber); Arvilla, Killdeer Mts. (E. & G. Wheeler, N. A. Weber); Mikkelson (J. E. Goldsberry); Grafton, Towner, Breien, junction of Cannonball and Missouri Rivers (N. A. Weber).

***Myrmica brevinodis* Emery ssp. *discontinua* n. ssp.**

Worker: Length 3.3—4.2 mm.

General habitus as in *brevispinosa*, with the following differences: Antennal scape at the base more compressed, with a distinct keel on the proximal part at the medial angle of the bend (when the scape is extended posteriorly towards the mid-occiput), which may be prolonged distally and bifurcated, following the lateral and medial margins for a slight distance; similar in this to *fracticornis* but the keel is not transverse, but V-shaped. Thorax, in profile, with feebly impressed mesoepinotal suture; epinotal spines slender, acute; in profile, produced backwards and upwards at a 40—50° angle, distinctly longer than the excision of the lamina beneath them; from above, distinctly longer than the distance between their bases, diverging. Postpetiole, in profile, less than $\frac{3}{4}$ as long as high.

Sculpturing of the head comparatively fine, most of the median dorsal surface closely and regularly rugulose, more open and reticulate on the sides. Dorsal surface of thorax moderately reticulate-vermiculate, becoming finer posteriorly, sides finely rugulose. Petiole feebly reticulate on dorsal surface; sides of pedicel thinly rugulose; dorsal surface of postpetiole smooth, except for punctations. Whole surface of body, except gaster, densely and conspicuously punctate.

Color dark brown; head and gaster nearly black.

Cotypes: A series of workers taken by W. M. Wheeler at Topaz Butte, Florissant, Colorado, July 15, 1906. Syntypes are from the following localities: Bay of Islands, Newfoundland (no collector); Pleasantfield, Nova Scotia (W. H. Prest); Mikkelson, North Dakota (J. E. Goldsberry); Yellowstone Park, Wyoming (A. C. Cole).

This variety can be readily distinguished from *brevispinosa* by the greater development of a keel on the scape, longer epinotal spines, smaller size and darker color. It appears closer to *fracticornis* but for the strikingly smooth and punctate surface. A male on the same pin with the North Dakota specimens is very much like a *fracticornis* male and with the antennal scape equal in length to from 5—6 of the following joints together. The Wyoming specimens have the thorax unusually smooth. The exact status of this form must await the certain correlation of the males.

The Nova Scotia workers were taken from their "nests in moss of meadow, a few inches above water (with aphids)."

***Myrmica wheeleri* n. sp.**

Worker: Length 3.3—4.2 mm.

Head, between eyes, 0.67 as wide as long (with mandibles); occipital margin straight; anterior clypeal border produced over base of mandibles in about a 130° lobe. Antennal scape exceeding the posterior margin of the head by a distance equal to its distal diameter; from above, when

extended posteriorly towards mid-occiput, in the form of a long drawn-out sigmoid curve, evenly bent at its proximal $\frac{1}{4}$, about 0.6 as wide proximally as distally; joints 1—2 of the funiculus together equal in length to joints 3—5 together; club 3-jointed, terminal joint equal in length to the preceding two joints together. Thorax, in profile, convex, with a slight but distinct mesoepinotal suture; epinotal spines, in profile, triangular with deflected apex, projected backwards and upwards at about a 45° angle, appreciably shorter than the declivity ventral to them, from above, about as wide as the distance between their bases, widely diverging. Petiole, in profile, with distinctly concave anterior face forming a sharp 90° angle with the convex dorsal surface; ventral surface concave, shorter from apex of ventral tooth to postpetiole than it is high; postpetiole, in profile, slightly higher than the petiole and higher than long, dorsal and ventral surfaces convex, the ventral convexity produced anteriorly as a lobe. Gaster ovate. Legs moderately long and slender.

Surface of head finely sculptured and shining, clypeus very sparsely and irregularly rugose, shining, frontal area triangular, smooth and shining, mid-dorsal surface longitudinally rugulose, becoming reticulate laterally and posteriorly. Thorax feebly sculptured, shining, with large, irregular vermiculations dorsally, feeble and sparse vermiculations on the sides. Petiole feebly vermiculate-reticulate on the node; postpetiole dorsally smooth and shining, laterally with a few irregular vermiculations. Base of the sculpturing of body, except gaster, densely, though shallowly punctate. Gaster, antennae and legs smooth and shining.

Pilosity comparatively abundant and fine, mostly truncate dorsally, subappressed on the legs; pubescence only on the antennal funiculi.

Color varying from light to dark ferruginous, head brown to dark brown, gaster with a broad, dark transverse band across the middle.

Female: Length 4.5—5.2 mm.

Closely resembling the worker. The epinotal spines vary in length from worker size and shape to shorter, blunt teeth. The petiole is higher and more distinctly separated into node and peduncle.

The sculpturing is appreciably coarser, the pronotum, on the sides, reticulate, rugose only at the posterior margin, thoracic sides otherwise rugose, scutum of mesonotum shining, with anteromedial triangular area punctate, otherwise feebly vermiculate, becoming more rugose posteriorly.

Color darker; head, thorax and transverse band across gaster dark brown; pedicel and appendages ferruginous. The thorax in several is ferruginous with brown blotches. Wings hyaline; veins pale brown, stigma large and pale brown in color.

Male: Length 3.6—4.3 mm.

Antennal scape equal in length to the following 3 segments together, subcylindrical, about $\frac{1}{4}$ as wide as long, bent slightly at the base; funicu-

lar club 4-jointed. Epinotal declivity dorsally with two slight, rounded gibbosities. Petiole, in profile, distinctly arched, anterior and ventral surfaces slightly concave, dorsal surface convex, slightly longer from apex of ventral tooth, or gibbosity, to postpetiole than it is high; postpetiole about $\frac{1}{3}$ higher than petiole and distinctly higher than long. Sagittae of the genitalia with about 17 serrations; volsellae unique in the absence of a medial tooth inside the hook.

Surface of the head finely and evenly punctate, nearly devoid of rugosities. Thorax largely punctate, smooth and shining mid-dorsally, a few scattered rugae on the sides; petiole punctate, with sparse, feeble rugae. Postpetiole and gaster smooth and shining.

Pilosity sparse, fine, acute.

Color brown, dark brown on the dorsal surfaces of the head and thorax. Wings hyaline with a purplish sheen; veins pale gray, stigma large and gray in color.

Described from two colonies collected by W. M. Wheeler, July 26 and 27, 1917, on Mt. Lemmon, 8—9,150 feet, and at Stratton, 6—7,000 feet, in the Santa Catalina Mts., Arizona.

This species could easily have been taken for a small form near *M. brevinodis* ssp. *brevisponsa* were it not for the utterly different volsellae of the male genitalia. The sculpturing of the worker and male is finer than in any other North American *Myrmica*; the short epinotal spines of the worker differ from those of *brevisponsa* in being stouter and deflected, resembling, in profile, the horns of *Bison bison*, the American buffalo.

The examination of hundreds of male genitalia and the uniformity in general habitus and size within a species convinces me that this ant can only be regarded as a distinctly new North American species. The volsellae of the genitalia are distinct from those in any other *Myrmica* and closest to those of *M. moravica* Soudek from Southern Europe.

The Life History of a Fungus-growing Ant of the Mississippi Gulf Coast

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During the summer of 1938 I was afforded an opportunity at Gulfport, Mississippi, to study the habits of an interesting fungus-growing ant, *Trachymyrmex septentrionalis obscurior* var. *seminole* Wheeler. The nests of these ants were first discovered in early June in a very open woods containing chiefly long-leaf pine, scrub palmetto, wild blackberry and mixed grasses (Fig. 1). The soil was of almost pure sand and its surface received

Fig. 1. Typical habitat of *T. seminole*, at Gulfport, Miss. This open growth of pines, grasses and scrub palmetto is characteristic of the Gulf Coast.



very little shade. Three zones of soil could be easily recognized, namely: (1) the surface layer of dry loose sand extending to an average depth of 11.3 cm.; (2) an intermediate zone, with a mean depth of 16.5 cm., consisting of tightly packed dry sand impenetrable by anything but a sharp instrument; and (3) a lower level of moist packed sand which extended down to the water-table. All nests which I discovered were in a habitat of this type, and none was found where these conditions did not prevail.

As a result of numerous observations I was able to reconstruct the life history of the ant. At the termination of the mating flight the female drops to the ground, sheds her wings and constructs in the second layer of soil (which is somewhat moist during later summer when colonies are founded) a cell about 4 cm. in length, 2.5 cm. in depth and 3 cm. in width. These incipient nests are established only where the sand is permeated by small roots, and the cell which the queen excavates is formed around one of these rootlets. At the nest entrance is a conical mound consisting of particles of sand which the queen has placed there during her excavations.

¹ Wheeler, W. M., "The fungus-growing ants of North America," *Bull. Amer. Mus. Nat. Hist.*, 23, Art. 31, (1907), Pl. LI. (See also p. 750.)

The queen leaves her chamber from time to time and forages near the nest. She returns with bits of leaves and insect excrement which she apparently masticates and deposits on the root that extends into the chamber from the side and either hangs freely about midway between the ceiling and the floor or passes completely through the chamber. Soon a small patch of fungus begins growing. In all of the fungus chambers I examined, the root in each extended into the chamber from the side or end but never

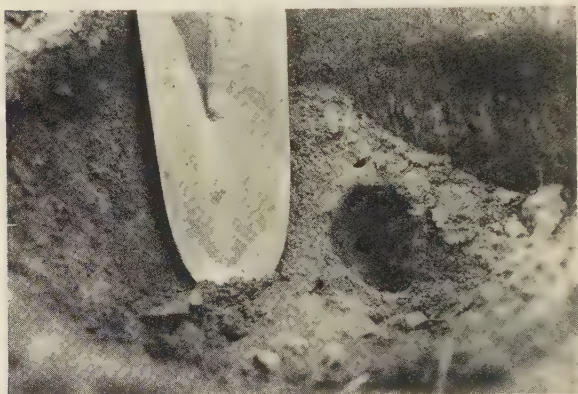


Fig. 2. Fungus chamber of *T. seminole*, at Gulfport, Mass. The trowel indicates the relative size of the chamber.

from the ceiling (as illustrated by Wheeler¹) or from the floor. In most nests the root passes completely through the fungus chamber so as to form a continuous foundation for the fungus garden. The fungus soon envelops the root and the branch roots. It grows in all directions and therefore only a part of it is actually pendant. In no chamber was it found to hang from the ceiling or to choke up completely the entire space. The fungus is a delicate spongy mass of hyphae and mycelia. It cannot be disturbed by the fingers without its falling apart, but it well withstands the weight of both brood and adults, and the ants move freely upon it and through its openings without damaging it. I was unable to find spore bodies at any time during the summer.

In the interstices of the fungus the queen deposits a small number of tiny eggs. These are soon engulfed by hyphae so as to form little packets. When the brood has matured and after the first workers have emerged, the egg-laying of the queen seems to be accelerated. The first brood of workers, which includes only a dozen or two individuals, constructs a gallery leading diagonally into the more moist lower layer of soil, and around a root excavates a chamber considerably larger than the original one. Its walls and ceilings are usually very smooth and rounded, its floor is flattened and its depth is very nearly as great as its width (Fig. 2).

The sand particles removed during the excavation of the chamber are carried to the nest entrance by the workers and deposited near it so as to

form a crescentic mound of sand. During nest enlargement the workers also make a circlet of bits of leaves around the nest entrance (Fig. 4). They carry to the nest pieces of dead leaves and insect excrement which are masticated by the ants and deposited on the root and branch roots in the newly constructed chamber. The fungus in the original chamber is probably also fertilized for a time, but when the garden in the new chamber becomes well established the first chamber is usually abandoned by the ants and in time its fungus garden and root die and are eliminated.

TABLE 1. Populations of Some Well Established Colonies of *T. seminole*, Gulfport, Miss., 1938*

Sample	Date	No. workers	No. males	No. females
1	June 8	64	0	0
2	" 9	101	0	12
3	" 16	84	2	25
4	" 18	39	19	21
5	" 26	67	12	35
6	July 2	117	21	43
7	" 10	73	15	22
8	" 29	114	8	13
9	Aug. 10	92	2	8
10	" 19	126	0	0

* All population figures represent the means of five random samples.

Meanwhile other broods have matured, and the workers may establish at lower levels in the moist sand additional chambers around roots.

The brood does not seem to be covered with hyphae; it rests on the fungus bed in the larger crevices of the garden. The larvae are grouped by developmental stages and the pupae are separated from them into a pile by themselves. In no nest did I observe large quantities of brood at any time during the summer. The colonies were not at all populous, and those containing more than one hundred and fifty workers may be considered unusually large ones (Table 1). It is of interest to note that many colonies at Gulfport contained almost as many males and females as workers just before the mating flight, and in a few of them the numbers of the sexes exceeded the number of workers. The queen was usually well within the confines of the fungus garden when the chamber was opened for examination, but on one occasion I discovered her ambling along the side of the mass. Some of the larger colonies contained two queens. A few females were found in nests on June 8, at Gulfport, and both winged castes were collected from colonies on June 11. By June 18 they were rather numerous. Table 1 lists the populations of some well established colonies at Gulfport. These were determined by removing and counting during midday all the ants from each nest in the series. Since this was accomplished during the period of aestivation, while all of the ants were within their nests, the

data should be significant. Mating flights at Gulfport were first observed on July 8 and they continued intermittently until the middle of August. All of the nests examined contained a greater number of females than males. During a short period just preceding the mating flight, both sexes would leave the chambers when the nests were opened and would fly a few inches at a time before scurrying for cover. Winged individuals were found in the larger crevices throughout the fungus gardens, while a few were observed in chambers which did not contain fungus.

The exterior part of the nest of a well established colony has usually a rather characteristic appearance (Fig. 3). There is a crescentic pile of sand varying from 12 cm. to 35 cm. in height. At the open end of the



Fig. 3. Typical external aspect of a nest of *T. seminole*, at Gulfport, Miss. Notice the crescentic mound of sand and the circlet of leaves beside the clump of grass. The forceps (11.5 cm. long) show the relative size of the nest.

crescent and near what would be the center, if the crescent were a circle, is the single nest entrance. This is usually about 4 mm. in diameter. Around the entrance is a circlet (40 mm. to 60 mm. in diameter) composed of bits of leaves placed there by the workers. This material closes the entrance entirely during dry weather. Beside the circlet there is frequently a small mound of sand which represents some of the particles excavated by the ants, and it is usually an addition to the pile left there by the queen. Although the exterior aspect of the typical nest is as described, some variability was apparent. Two of the mounds I observed were in the form of a complete or an almost complete circle with the nest entrance and the circlet of leaves near the center (Fig. 4).

There is considerable variation in the number and position of the chambers and galleries in the nests. This is shown in Figure 5, which illustrates samples of all the major variants encountered. The nests are represented by diagrammatic sections. Nest A is of the usual type. It shows first of all the entrance gallery leading obliquely to the first chamber, which is the one constructed by the queen and which composed part of the incipient

Fig. 4. An almost circular sand mound of *T. seminole*, near Gulfport, Miss. The circlet of leaves is very obvious.



nest. When the nest was enlarged, this small chamber was abandoned as a fungus compartment and, if used at all by the ants, it serves as a temporary repository for foreign material which the workers eventually remove. The second gallery extends diagonally to the second chamber which is much larger than the original one and which may or may not contain a

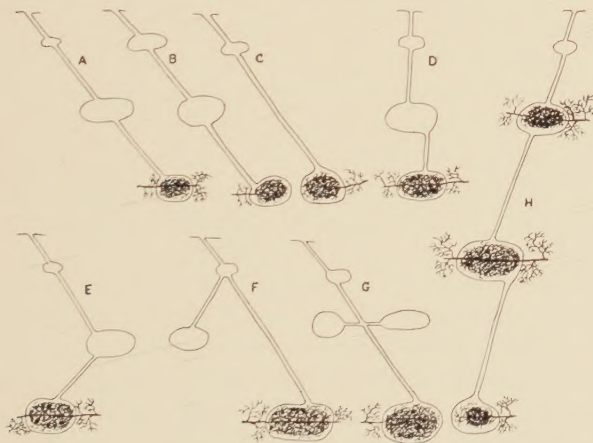


Fig. 5. Internal aspect of nests of *T. seminole*, at Gulfport, Miss. A, the usual type of nest; B-H, modifications of nest structure.

fungus garden. During the drier part of the summer I found only one nest which had this second chamber occupied by fungus, but in later summer when rains were relatively frequent the second chamber invariably contained a fungus garden. These data are summarized in Table 2. During the former period the intermediate layer of soil was extremely dry whereas at a later time moisture was present in an amount sufficient for the succulent growth of fungus. Figure 2 shows a second chamber and the opening of another gallery. The third gallery leads from the median chamber to the basal one which invariably supported a fungus garden. As a rule this was the largest chamber of the three and was more spherical than the

TABLE 2. Number of Fungus Chambers and Gardens in Nests of
T. seminole; Gulfport, Miss., 1938

Sample	Date	No. of fungus chambers in nest*	No. of fungus gardens in nest	Depth of basal chamber from nest entrance**
1	June 10	2	1	33.8 cm.
2	" 22	2	1	27.7
3	July 2	2	1	47.0
4	" 12	2	1	40.9
5	" 23	2	1	35.1
6	" 30	2	2	37.2
7	Aug. 5	3	2	89.2
8	" 16	2	2	65.3
9	" 23	2	2	43.7

* The small chamber constructed by the queen is not considered as even a possible fungus chamber unless it has been enlarged by the workers. The data in the table do not include this exception.

** These measurements were taken from the soil surface to the floor of the basal chamber and represent actual vertical depths.

others. Here the fungus in some nests was so dense that it all but filled the cavity. This third chamber was always found in the lower soil level, which retained a considerable amount of moisture during even the driest periods of summer. It was in this chamber that the brood was usually confined, although a small amount of brood, many workers and some of the winged individuals (when present in the nest) occupied the median chamber, if it contained fungus.

A common variation of the typical nest is illustrated as Nest B in Figure 4. The drawing indicates that the incipient chamber had probably been enlarged by the workers. While it may have been used as a fungus chamber during the less dry seasons of the year, there was no evidence of its occupancy during the summer. Nest C illustrates a two-chambered nest in which a long gallery leads from the unenlarged original chamber through the drier soil level to a single large chamber in the moist layer of sand. The colony which occupied this nest was unusually populous and appeared to be thriving on a large succulent mass of fungus.

An unusual departure from the typical diagonally directed galleries is shown in Nest D. In this nest (which illustrates one of two of this type discovered) all three of the galleries are directed almost straight downward, this being a condition which prevails among nests of *T. turricifex* Wheeler, of Texas. Nest E shows a third gallery leading from the floor of the second chamber to the ceiling of the terminal chamber which is on a line almost vertical with the nest entrance. Nest F exhibits two galleries leading from the uppermost chamber, one of which connects to a chamber beneath it while the other is directed diagonally to a third and larger chamber. Of the scores of nests examined, this and Nest G are the only

patterns which showed no duplication. Nest G had two lateral chambers in the dry sand level, one being elongated and the other spherical. Each was connected at the same point to the main gallery by a short passage. These chambers contained a few males and females on July 2. The main gallery extended into the moist sand where it joined a very large basal chamber containing a succulent fungus garden. Neither of the two lateral chambers contained fungus at the time the nest was opened for examination. The only other nest found which was composed of more than three chambers was a simple diagonal chain of galleries and four chambers. This nest, which was studied in early August, is illustrated as Nest H. Fungus gardens were present in the three basal chambers, that of the terminal one being very small.

The galleries are nearly circular, about 7 mm. in diameter and usually lead directly to the chambers diagonally in a straight line. Only rarely did I find a gallery with a bend in it. The gallery leading from the nest entrance through the loose sand to the first chamber is a tube of compact sand, which indicates that the workers moisten the matrix and that the queen probably had to do likewise in order to construct the original gallery. In the layer of compact sand there is no indication that the galleries have been reinforced in any way. The depth from the nest entrance to the floor of the terminal chamber in a series of twenty-five typical nests varied from 31.2 cm. to 58.1 cm., with a mean of 40.3 cm.

The mounds of sand which were so prominent during the summer were materially leveled by the elements later in the season, and since little material was added to them after the nest galleries and chambers had been completed, they all but disappeared. The circlet of leaves at the entrance remained, however, and additional detritus was added to it by the workers from time to time.

During my collecting activities near Landon, Mississippi, on July 30, following a day and a night of heavy rains, I observed several nests of what appeared to be those of *seminole*. The rain-leveled crescentic areas of sand were clearly visible and the circlets of leaves about the entrances were evident. They differed, however, from nests that I had previously examined at Gulfport in that a turret of packed sand and bits of leaves extended from the entrance of each nest. The turrets varied somewhat in height, but most of them were about 40 mm. tall. One of these turrets is illustrated in Figure 6. Each turret was approximately 12 mm. in diameter and contained a single opening about 7 mm. in diameter. Several nests were opened and examined and the ants proved to be the same kind as those encountered at Gulfport. The interior of each nest was similar to the nests previously studied. The nests at Gulfport were immediately visited and each was found to bear a turret. I have been unable to find these supplementary nest structures mentioned in the literature on *T. septentrionalis* or any of its subspecies or varieties. The turret resembles

closely that of *T. turrifex*, but the orifice is of a greater diameter and the entire turret is composed of different materials. It is possible that the turrets represent an arrangement whereby water is prevented from entering the nest chambers through the gallery. Wheeler² states that the presence of the turret of *T. turrifex* is one respect in which "the external structure of the nest is very different from that of *septrionalis*."

The workers are timid slow-moving insects, and their foraging for bits of leaves and insect excrement must consume a great deal of their time.



Fig. 6. A turret on a nest of *T. seminole*, near Landon, Miss. Notice the large entrance. The five-dram vial shows the comparative size.

If they are disturbed, their pace is only slightly increased. When a nest containing the winged castes is opened, the workers mill about, amble for cover and leave the fast-moving sexes to fend for themselves. They do, however, transport brood and bits of the fungus garden to places of greater safety. Whenever I opened a fungus chamber the ants streamed out in a short-lived ferocious attitude. I was unable to entice the ants to bite me. Indeed, the movement of the ants is deceptive, since it is apparently neither offensive nor defensive. The queens move far more slowly than do the workers. Many of the workers feign death, but I have not seen a queen or winged caste do so. In summer, except on cool days, the workers are active only during the night, early morning and late afternoon. When outside temperatures are high the ants plug the nest entrance with bits of leaves and reside in the fungus chambers.

One of the chief enemies of this fungus-growing ant at Gulfport was *Eciton*, a genus of legionary ants. On several occasions I observed long files of *E. schmitti* leading from their own nests to those of the fungus-grower. The marauders carried off males, females, brood and bits of the fungus garden and deposited them in their subterranean chambers. In a nest of *E. schmitti* I found great numbers of foreign brood and males and females of *T. seminole*, some of which had already been partially eaten.

² Wheeler, *op. cit.*, p. 755.